Microbiological Profile of Childhood Pneumonias in Hyderabad, India

Vipparti Haritha* and V.V. Shailaja

1Department of Microbiology, Malla Reddy Institute of Medical Sciences, Hyderabad, Telangana state, India
2Department of Microbiology, Gandhi Medical College, Hyderabad, Telangana state, India

*Corresponding author

Abstract

The present study was undertaken from 30/6/11 – 14/8/12 to know the Bacterial, and Mycological profile profile and drug susceptibility patterns in children suffering from pneumonias. Sputa (expectorated and induced) and Pleural fluid were collected from 113 cases and processed by conventional methods. Antibiotic sensitivity testing of these isolates was done as per CLSI guidelines. Bacterial pathogens were isolated in 44.25% of cases from both Sputum and Pleural fluid. *Klebsiella pneumoniae* was the predominant isolate 28% followed by *Pseudomonas aeruginosa* 24% and *Staphylococcus aureus* 22%. 72% of *Staphylococcus aureus* strains were Methicillin Resistant. *Candida albicans* was the most common isolated fungi 6.2% followed by *Non Albicans Candida* from sputum samples. Pleural fluid cultures for fungi were negative. Respiratory tract infections are a significant public health problem in developing countries. Timely detection followed by expeditious identification of pathogens and determination of susceptibility to antimicrobial agents can have a great diagnostic and prognostic importance.

Keywords: Bacteria, Gram negative, ESBL, MRSA, Fungi, Pleural fluid.

Introduction

Lower respiratory tract infections are a persistent and pervasive public health problem, placing a considerable strain on the health budget and are generally more serious than upper respiratory tract infections. They cause a greater burden of disease worldwide than human immunodeficiency virus infection, malaria, cancer, or heart attacks (1).

Pneumonia is a form of acute Lower Respiratory Tract Infection that affects the lungs and has being the single largest cause of death in children. Worldwide, 35-40% mortality among children aged less than 5 years is attributed to respiratory tract infections accounting for 2.04 million deaths/year. In India, more than 4 lakh deaths every year are due to pneumonia accounting for 13%-16% of all deaths in the pediatric hospital admissions (2, 3).

Clinicians use a wide range of disease definitions, such as tracheitis, acute bronchitis, bronchiolitis and pneumonia, depending on the symptoms and signs and anatomic structure involved, aspiration pneumonia, obstruction pneumonia and ventilator-associated pneumonia based on...
pathogenesis and community acquired pneumonia and hospital-acquired pneumonia based on the location where infection was acquired.

Nevertheless, pneumonia is considered as the most serious condition and is almost always treated with antibiotics.

LRTI is caused by several infectious agents, including viruses, bacteria and fungi (2). Traditionally, the infections of the upper respiratory tract are thought to be predominantly of viral origin and the infections of the lower respiratory tract of bacterial origin (4).

But viruses are also known to cause pneumonia, e.g. the Influenza-virus and the novel Coronavirus that causes severe acute respiratory syndrome (4).

Bacterial pneumonia is usually the result of Streptococcus pneumoniae or Haemophilus influenzae, especially type b, and rarely Staphylococcus aureus or other streptococci. Chlamydia pneumoniae and Mycoplasma pneumoniae cause atypical pneumonias (5).

Among the vast diversity of respiratory pathogens, fungi account for only a small portion of community-acquired and nosocomial pneumonias.

However, fungal respiratory infections generate concern in the expanding population of immunosuppressed patients (6).

Opportunistic fungal organisms (e.g., Candida species, Aspergillus species, Mucor species) tend to cause pneumonia in patients with congenital or acquired defects in the host immune defenses.

The present study was undertaken to note the prevalence of various Bacterial and Fungal Pathogens causing LRTI in children and an attempt was also made to examine P. jirovecii in induced sputum and for Nocardia spp.

Materials and Methods

As there is a paucity of studies in the Indian setting to find out incriminating bacterial agents in children suffering from lower respiratory tract infections, this study was undertaken to determine the prevalence of Bacterial and Fungal etiologic agents of lower respiratory tract infections and their antimicrobial susceptibility pattern in children.

Place of study

In a tertiary care hospital, Hyderabad.

Duration

The present study was undertaken for a period of one year i.e. from 30/6/11 – 14/8/12.

Study group comprises of children clinically diagnosed as cases of Pneumonias belonging to age group 0 – 18 years.

Specimen

Early morning expectorated sputum from two consecutive days was collected in sterile containers from all patients included in the study.

Induced sputum samples were collected in addition to expectorated sputum in those children who had difficulty in expectorating sputum and in those with underlying immunocompromised disease. Induction of sputum was done using a Nebulizer and 3% hypertonic saline. Induced sputum is watery and was accepted. Sputum was considered unsuitable if it had a final score of 0 or less by Bartlett’s scoring system.
Pleural fluid was also collected and processed from few cases.

**Processing**

Specimen was first observed macroscopically whether, Mucoid, Purulent, Mucopurulent or any Blood tinge.

**Culture**

Sputa and pleural fluids were inoculated on the following culture media and processed.

Blood agar
Chocolate agar
MacConkey agar
Sabouraud’s dextrose agar with and without antibiotics. – For fungi.

All the bacterial isolates obtained were identified conventionally by standard biochemical tests.

Two of the gram negative non fermenting bacilli identified conventionally were also confirmed as *S. maltophilia* and *B. cepacia* by VITEK 2. (BIOMERIEUX)

**Control strains used**

ATCC *S. aureus*: ATCC 12228, ATCC *E. coli*: ATCC 25922

**Antibiotic sensitivity testing**

The Antibiograms of bacterial isolates were determined by Kirby –Bauer’s Disk Diffusion method and the Zone diameters were interpreted as per NCCLS guidelines

**Results and Discussion**

The total number of children suffering from LRTI included in the study during the one year period was 113.

Among a total of 11(22%) isolates of *Staphylococcus aureus* 8 (72.72%) were Methicillin resistant.

One isolate of *Streptococcus pyogenes* and four isolates of *Streptococcus pneumonia* were found to be sensitive to all the antibiotics tested.

One isolate of *Enterobacter* spp was obtained which was resistant to Penicillins and Cephalosporins and was sensitive to Carbapenams and Cotrimoxazole.

All the induced sputum samples which were stained by Giens technique were negative for trophozoites and cysts of *Pneumocystis jirovecii*.

All the sputa and pleural fluid samples stained by modified Zeihl Neelsen’s staining were negative for *Nocardia* spp.

Acute lower respiratory infections are the most common cause of infectious diseases in children worldwide. Despite effective vaccines and nutritional and environmental interventions, they constitute a major cause of mortality in children aged less than five years, leading to an estimated 1.9 million deaths annually (7). WHO recognized respiratory diseases as the second important cause of death for children fewer than five years in 2010 and also these children with signs of pneumonia are more likely to have a bacterial etiology (7).

In the present study bacteria as an etiologic agent for lower respiratory tract infections were identified in 55 (48.6%) cases. Culture positive rate is higher in the present study possibly because it was done in a tertiary care hospital.

In the present study majority of the bacterial pathogens were isolated in children less than
five years of age. Similar findings were observed by Akiyoshi Nariai et al., in a study who found that Bacterial pathogens were isolated with high frequency in children less than 7 years of age (13).

48.6% was the culture positive rate obtained. *Klebsiella pneumoniae* was found to be the most predominant organism causing LRTI in studies done by Okesola et al., (2008), Juhitaneja et al., (2009) (32.2%) and Dong et al., (2006) (9.9%). This correlated well with the present study, among the Gram negative bacteria, *Klebsiella pneumoniae* (25.45%) was the most common pathogen isolated.

Incidence of *Pseudomonas aeruginosa* as an etiologic agent for LRTI was observed to be variable in various studies. HUA Chun-Zhen reported an incidence of (6.4%) and 9.1% incidence was reported in a study done by LüBo, Mo WeiXiong et al., (9, 11). However in the present study 22% of the isolates were *Pseudomonas aeruginosa*. Chun- Yi- Lee et al., observed a high isolation rate of 35.4% (21).

The respiratory system is the most common site for infection by Acinetobacter in immunocompromised patients and hospitalized patients, proving the statement, 2% of isolates of *Acinetobacter* spp were isolated from majority of the inpatients.

*M. catarrhalis* was isolated in 4% of cases. It is generally considered a commensal in the upper respiratory tract of adults, and its isolation from sputum is often reported as “normal flora of the oropharynx”. However, Chong Chia YIN et al., reported this organism as a pathogen causing lower respiratory tract infections in children (22). Repeat sampling was necessary to prove and confirm the organism as the etiologic agent of the respiratory infection.

*Age distribution of cases in years: n=113*
Antibiotic Susceptibility pattern of Staphylococcus aureus

Antibiotic sensitivity pattern of Eschericia coli
Antibiotic sensitivity pattern of Klebsiella pneumonia

Antibiotic sensitivity pattern of Pseudomonas aeruginosa
### Table 1 - Percentage of cases from which bacteria were isolated:

\[ n = 113 \]

| Culture               | Number | %    |
|-----------------------|--------|------|
| Sterile               | 63     | 55.75% |
| Pathogens isolated    | 50     | 44.25% |

### Table 2 - Bacterial isolates obtained

| Bacterial isolate       | No. of isolates | No. of isolates | Total | %  |
|-------------------------|-----------------|-----------------|-------|----|
|                         | Sputum          | Pleural fluid   |       |    |
| Klebsiella pneumoniae   | 10              | 4               | 14    | 28 |
| Pseudomonas aeruginosa  | 7               | 5               | 12    | 24 |
| Staphylococcus aureus   | 4               | 7               | 11    | 22 |
| Escherichia coli        | 3               | 1               | 4     | 8  |
| Moraxella spp.          | 2               | 0               | 2     | 4  |
| Streptococcus pneumoniae| 1               | 1               | 2     | 4  |
| Streptococcus pyogenes  | 1               | 0               | 1     | 2  |
| Enterobacter spp.       | 0               | 1               | 1     | 2  |
| Acinetobacter spp.      | 0               | 1               | 1     | 2  |
| Burkholderia cepacia    | 0               | 1               | 1     | 2  |
| Klebsiella pneumoniae+  | 1               | 0               | 1     | 2  |
| Stenotrophomonas maltophilia | 0     | 1               | 1     | 2  |

TOTAL: 29 | 21 | 50 | 100 |

### Table 3 - Methicillin Resistance among Staphylococcus aureus

\[ n = 11 \]

| Staphylococcus aureus | No. of isolates | Percentage |
|-----------------------|-----------------|------------|
| Methicillin resistant  | 8               | 72.72%     |
| Methicillin sensitive  | 3               | 27.28%     |
### Table 4: Sensitivity patterns of *Burkholderia cepacia* and *Stenotrophomonas maltophilia*

| ANTIBIOTIC                  | *Burkholderia cepacia* (1) | *Stenotrophomonas maltophilia* (1) |
|-----------------------------|----------------------------|-----------------------------------|
|                            | S  | R  | S      | R  |
| Ticarcillin / clavulanic acid | 100 | 0  | 100    | 0  |
| Ceftazidime                 | 100 | 0  | 100    | 0  |
| Meropenem                   | 100 | 0  | Not tested | Not tested |
| Levofoxacin                 | 100 | 0  | 100    | 0  |
| Cotrimoxazole               | 100 | 0  | 100    | 0  |
| Chloramphenicol             | 100 | 0  | 100    | 0  |

### Table 5: Fungal isolates

| Fungal isolates         | Sputum | %    | Pleural fluid | %    | Total | % |
|-------------------------|--------|------|---------------|------|-------|---|
| *C. albicans*           | 7      | 13.21| 0             | 0    | 7     | 6.2|
| *Non albicans candida*  | 2      | 3.77 | 0             | 0    | 2     | 1.77|
| Mixed                   | 1      | 1.89 | 0             | 0    | 1     | 0.88|
| *Pneumocystis jiurovecii* | 0    | 0    | 0             | 0    | 0     | 0  |
| *Nocardia spp.*         | 0      | 0    | 0             | 0    | 0     | 0  |
| No fungal growth        | 43     | 81.13| 60            | 0    | 103   | 91.15|

### Table 6: Comparison of bacteria isolated in present and various studies

| Studies done              | Bacteria Isolated | Gram negative bacteria | Gram positive bacteria |
|---------------------------|-------------------|------------------------|------------------------|
| Wang Y et al in (8).       | 26 %              | 69%                    | 20.55%                 |
| Hua Chun-Zhen et al (9).   | 25%               | --                     | --                     |
| Hanna Nochynek et al (10). | 25%               | --                     | --                     |
| Lübo, Mo Weixiong et al (11) | 25.1%          | 35.6%                  | 64.4%                  |
| Shailaja et al (12).       | 44.3%             | --                     | --                     |
| Present study             | 48.6%             | 75%                    | 25%                    |
Table 7: Comparison of split up of bacterial isolates obtained in the present and various studies

| Author                        | S. aureus | S. pneumonia | K. pneumonia | P. aeruginosa | E. coli | Acinetobacter |
|-------------------------------|-----------|--------------|--------------|---------------|---------|---------------|
| D Narayanappa, et al (14)     | 15 (30%)  | 4 (8%)       | --           | --            | --      | --            |
| Vikramjeet Dutto, et al (15)  | (16%),    | (54%)        | 8%           | 6%            | 6%      | --            |
| Batmunkh Nyambat et al (16)   | n=126     | n=83         | n=35         | n=37          | n=34    |               |
| A.M. Lingayat et al (17)      | 45.45%    | 22.7%        | --           | 18%           | --      | --            |
| Wang Y et al (8)              | 9.7%      | --           | 10.8%        | 17%           | 10.7%   | 9.03%         |
| Present study                 | 20%       | 4%           | 25.45%       | 22%           | 7%      | 11%           |

Table 8: Incidence of MRSA in various studies

| Study                                      | MSSA % | MRSA % |
|--------------------------------------------|--------|--------|
| Present study                              | 36.7   | 63.3   |
| AlexanderKallen (27)                       | 58.5   | 41.5   |
| Study in US in 2001-2002 (28)              | 22     | 78     |
| D Narayanappa, et al (14)                  | 73.4   | 26.6%  |
| Vikramjeet Dutto et al (15)                | 100%   | 0%     |

Table 9: Fungal isolates in various studies.

| Author                                      | % isolated | Predominant isolate                        |
|---------------------------------------------|------------|--------------------------------------------|
| B.V. Navaneeth et al (29)                   | 8.9%       | --                                         |
| Shailaja et al (12)                         | 12.8%      | --                                         |
| Parvez Anwar Khan et al (30)                | 8.7%       | Candida, Aspergillus                       |
| Jithendra Kandati et al (31)                | 34%        | Pneumocystis, Leishmania, Candida, Aspergillus, Cryptococcus |
| Present study                               | 8.85%      | Candida                                    |

1907
**Microscopic Examination: The following staining techniques were performed**

| Staining Technique | Description |
|--------------------|-------------|
| Gram’s stain       | To assess adequacy of sample. (Bartlett’s grading) For capsulated gram positive diplococci in sputum and gram positive and gram negative organisms in pleural fluid. |
| Giemsa stain       | For *Pneumocystis jirovecii* in nebulised sputum. |
| KOH mount          | For fungal elements. |

The etiological diagnosis of LRTI is frequently confounded by the presence of commensal flora, as well as that of potentially pathogenic organisms in the oropharynx.

The increasing trend of antibiotic resistance in respiratory bacterial pathogens poses a challenge for empiric treatment with conventional agents. Infections with drug resistant organisms lead to longer hospital stays, increased mortality, and greater costs of hospitalization.

Inappropriate initial antibiotic therapy is a potentially modifiable factor that has been associated with increased mortality in patients with serious infections. Hence antibiotic sensitivity testing help the clinician to select empirical antibiotics based on Gram stain, culture findings and susceptibility to various antimicrobials.

Hua et al., (2006) showed Antibiotic susceptibility tests showed that rates of ESBL (extended spectrum beta lactamase) -positive *Klebsiella pneumoniae* and *Eschericia coli* were 42.6% and 4.5%, respectively.

Juhi Taneja et al., in their study showed ESBL production rate was as follows: *Klebsiella pneumoniae* (46.1%), *Eschericia coli* (57.1%) and *Pseudomonas aeruginosa* (75%) (19). 9 isolates of *Klebsiella* and 3 isolates of *Escherichia coli* were ESBL producers in our study.

Chun- Yi- Lee et al., observed that *Staphylococcus aureus* was the most common Gram positive organism isolated from children suffering from LRTI (21). This correlated well with the present study where *Staphylococcus aureus* (22%) was the most common Gram positive bacteria isolated.

The rate of admission with a diagnosis of empyema increased over the last decade, most notably in children aged 1-4 years. In addition, the identification of *Streptococcus pneumoniae* as the primary pathogen though has been reported in various parts of the world its isolation rate have stabilized over the last decade, the rate of bacterial resistance, specifically methicillin resistant *Staphylococcus aureus*, has predominated.

After the universal use of the pneumococcal conjugate vaccine, 3 major changes have occurred 1) the number of patients admitted with empyema has decreased 2) the prevalence of *S. pneumoniae* has decreased and 3) *Staphylococcus aureus* has become the most common pathogen majority of those being methicillin resistant.

Bacteria from pleural fluid was isolated in 35% of cases in our study and when compared with various other studies it was found that Lochindarat et al., found 18.3% pleural fluid culture positive cases, Karen D. Schultz et al., in 2004 and Ghosal, et al., in 1996 observed an isolation rate of 32% and 26.5% respectively (24, 25, 26).

11.67% was the isolation rate of *Staphylococcus aureus* from pleural fluid in the present study. This was similar to study done by Karen D. Schultz, et al., who observed that *Staphylococcus aureus* was the
most common pathogen isolated (18%) in pleural fluid samples (25). Both the isolates of Streptococcus pneumoniae were sensitive to Ampicillin. This correlated with Juhtaneja et al., in 2009 reported that all the Streptococcus pneumoniae isolates were sensitive to Ampicillin (19).

Fungal Pneumonia in children is a rare condition, and is often seen in individuals with compromised immune system like AIDS. The most common fungal agents that cause pneumonia in children are Histoplasma capsulatum, Cryptococcus neoformans, Pneumocystis jiroveci, Blastomyces and Coccidioides immitis. Pneumocystis jiroveci pneumonia (PCP) in particular is a common, serious infection among HIV-infected children and is associated with high mortality.

In the present study out of 113 sputum and pleural fluid samples processed, 91.15% showed no fungal growth.

However in the present study though 12 children presented with underlying immunocompromised disease, and in all these patients induced sputa were collected in addition to expectorated sputum samples, no Trophozoite or cysts of Pneumocystis jirovecii observed. Sputum and pleural fluid samples which were stained by Modified acid fast

Techniques using 1% sulphuric acid were negative for Nocardia spp.

No attempt was made to for viral cultures due to lack of facilities. No attempt was made for anti-fungal sensitivity testing in the present study.

The prevention of repeated infections and the early detection and management of chronic lung disease is critical to the long-term respiratory and overall health of children.

The present study helps to know the prevalence of pathogens causing respiratory tract infections and also helps the clinician in guiding antibiotic therapy which is very essential particularly in children to prevent them from landing in more serious complications.

References

1. Joseph P. Mizgerd. Acute Lower Respiratory Tract Infection. Review article. New England Journal of Medicine. 2008; 358:716-727. doi: 10.1056/NEJMra074111.  
2. Pneumonia facts sheet –WHO Updated September 2016.  
3. Kalaiselvi Selvaraj, Palanivel Chinnakali, Anindo Majumdar, Iswarya Santhana Krishnan, et al., Acute respiratory infections among under-5 children in India: A situational analysis. Journal of Natural Science and Biology Medicine. 2014 Jan-Jun; 5(1): 15–20. doi: 10.4103/0976-9668.127275.  
4. AW Graffelman. Chapter II Lower respiratory tract infections: a review of the literature https://openaccess.leidenuniv.nl/bitstream/handle/1887/3732/02.  
5. Mohammad Reza Boloursaz, Ferial Lotfian, Farahnaz Aghahosseini, Ali Cheraghvandi, Soheila Khalilzadeh, Ali Farjah and Maryam Boloursaz. Epidemiology of Lower Respiratory Tract Infections in Children. Journal of Comprehensive Pediatrics. 2013 May; 4(2): 93-8., DOI: 10.17795.  
6. Author: Romeo A Mandanas, MD, FACP. Fungal Pneumonia: Overview of Fungal Pneumonia. Medscape, Updated: Jul 22, 2016.  
7. David R Marsh, Kate E Gilroy, Renee Van de Weerd, Emmanuel Wansi, Shamim, Qazi.: Bulletin of the World Health Organization (BLT) Community
case management of pneumonia: at a tipping point? May 2008 Volume 86, Number 5, 321-416.

8. Wang Y, Zhang R, Li W, Feng Y, Leng T. Serious antimicrobial resistance status of pathogens causing hospital-acquired lower respiratory tract infections in North China. Journal of International Medical Research. 2009 May-Jun;37(3):899-907. DOI: 10.1177/03000600903700336.

9. HUA Chun-Zhen, YU Hui-Min, CHEN Zhi-Min, LI Jian-Ping, and SHANG Shi-Qiang: Pathogenic bacteria of childhood lower respiratory tract infection. Chinese journal of antibiotics. 2006-03.

10. Hanna Nohynek, MD; Juhani Eskola, MD; Eija Laine, MD; Pekka Halonen. The causes of hospital-treated acute lower respiratory tract infection in children. American Journal of Diseases of Children. 1991; 145(6):618-622. DOI:10.1001/archpedi.1991.02160060036016

11. Liu Bo, Mo Wei Xiong, Huang Yu Huan, Li Hai Zhu Analysis of pathogens of lower respiratory tract infection in children. China. Journal of Tropical Medicine.2005-04.

12. VV.shailaja, LA pai, Dr.Mathur, V.Lakshmi. Prevalence of bacterial and fungal agents causing LRTI in patients with HIV. Indian Journal of Medical Microbiology. 2004 Jan-Mar; 22(1):28-33.

13. Akiyoshi Nariai et al., Bacteriological view of lower respiratory tract infection in children seen in regional hospital in Yokohama. Volume 1257, December 2003, Pages 105-109.

14. D Narayanappa, N Rashmi, NA Prasad, and Anil Kumar. Clinico-bacteriological Profile and Outcome of Empyema. Indian journal of paediatrics.2013; 50:783-785.

15. Vikramjeet Dutta, Annie Bakorlin Khyriem, Ishani Bora, Himesh Barman et al., Bacteriological Profile of Pleural Fluid among the Paediatric Population In A Tertiary Care Centre - A Retrospective Analysis. International Journal of health sciences and research. 2015; 5(9): 167-17421.

16. Batmunkh Nyambat, Paul E Kilgore, Dong Eun Yong, Dang Duc Anh, Chen-Hsun Chiu, Xuzhuang Shen Survey of childhood empyema in Asia: Implications for detecting the unmeasured burden of culture-negative bacterial disease.Bio med central for Infectious Diseases.20088:90 DOI: 10.1186/1471-2334-8-90.

17. A.M. Lingayat, P.R. Wankhade. Study of clinical profile, etiological bacterial agents and outcome in pediatric patients of empyema. Indian Journal of Basic and Applied Medical Research. March 2015: Vol.-4, Issue-2, P. 502-509.

18. A.O. Okesola1 and O.M. Ige. Trends in bacterial pathogens of lower respiratory tract infections. Indian Journal of Chest Diseases and Allied Sciences. Volume 2008; issue 50:pages 269-272.

19. Juhitaneja, Abidamalik, Ashraf Malik, Meher Rizvi and Mithlesh Agarwal. Acute Lower Respiratory Tract Infections in children: Short communication: Indian journal of paediatrics. JUNE 17, 2009 Published online: 2009 Jan1.pii-019606107007292.

20. Dong L, Zhou XC, Chen XF, Yang JH, Lin J, Zhang HL et al., Detection of etiologic agents and antibiotic resistance in children with acute lower respiratory tract infection in Wenzhou City. Chinese journal of contemporary paediatrics. 2006 Oct;8(5):369-72.

21. Chun-yi-lee, po-yen -chen et al., Microbiologic spectrum and susceptibility pattern of clinical isolates
from paediatric intensive care units in a single medical centre. Journal microbial immunology and infectious diseases. 2009; 42: 160-165.

22. Chong Chia YIN, Lim Woan HUAH, Jenny Tang Poh LIN, Anne Goh, Ho LING, Chay Oh MOH. Correspondence: Lower respiratory tract infection in hospitalized children KK Women's & Children's Hospital. Respiratory, 8: 83–89. Doi: 10.1046.

23. Chun-Zhen Hua 1, Hui-Min Yu, Zhi-Min Chen, Jian-Ping Li, Shi-Qiang Shang Pathogenic Bacteria of Childhood Lower Respiratory Tract Infection. Chinese journal of contemporary paediatrics. 2006. 8 (5), 365-368. 10.

24. Lochindarat S. Teeratakulpisarn J, Warachit B, Chanta C, Thapa K, Gilbert GL et al., Bacterial etiology of empyema thoracis and parapneumonic pleural effusion in Thai children aged less than 16 years. Southeast Asian Journal of Tropical Medicine and Public Health. 2014 Mar; 45(2):442-54.

25. Karen D. Schultz, MD, Leland L. Fan, MD, Jay Pinsky, B, Lyssa Ochoa et al. The Changing Face of Pleural Empyemas in Children: Epidemiology and Management. Official journal of the American academy of paediatrics. June 2004, volume 113 / Issue 6.

26. A.G. Ghosal, S. Ghosh, et al.; Sputum AFB Positivity in Tuberculous Pleural Effusion with No Radiologically Apparent Parenchymal Lung Lesion. Indian Journal of Tuberculosis., Volume 1997, issue 44, pages 13.

27. Will Dunham- Staph caused pneumonia more common – CDC. HEALTH NEWS | Thu Mar 20, 2008.

28. Lbi.E. Methicillin-resistant Staphylococcus aureus pneumonia in children: a call for increased vigilance. The southern medical journal. 2005 Nov; 98(11):1059-60.

29. B.V. Navaneeth and M.R. Sandhya Belwadi. Antibiotic Resistance among Gram-negative Bacteria of Lower Respiratory Tract Secretions in Hospitalized Patients. Indian Journal of Chest Diseases and Allied Sciences. 2002; 44: 173-176.

30. Khan PA, Malik A, Fatima N, Shameem M. Profile of Fungal Lower Respiratory Tract Infections and CD4 Counts in HIV Positive Patients. Journal of Virology and Mycology. 2013. 2: 113. doi:10.4172/2161-0517.1000113.

31. Jithendra Kandati, Suresh Kumar Boorsu, Muni Lakshmi Ponugoti, Vedadruthy Samudrala. Bacterial and fungal agents causing lower respiratory tract infections in patients with human immunodeficiency virus infection. International Journal of Research in Medical Sciences. 2016; 4(8): 3595-3600 doi: 10.18203/2320-6012.

How to cite this article:

Vipparti Haritha and Shailaja, V.V. 2017. Microbiological Profile of Childhood Pneumonias in Hyderabad. Int. J. Curr. Microbiol. App. Sci. 6(8): 1899-1911. doi: https://doi.org/10.20546/ijcmas.2017.608.224