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Possible Etiological Agents of Pneumonia in Egyptian Infants and Children

William M Morcos[1], Ashraf Azmy[1], Mones M Abushady[1], Hisham W Moustafa[1]*, Amira Ahmed[2], Hala Atta[2]

[1]Departments of Child Health, National Research Centre, Egypt
[2]Neonatology, El Galaa Teaching Hospital, Egypt

ABSTRACT

Community acquired pneumonia is more prevalent and severe in developing countries than in developed one. In Egypt, pneumonia accounts for 11% of deaths in children under 5 years old. In developing countries more than 150 million new cases occur in children under 5 years annually. Our objective was to determine and evaluate the possible etiological agents of pneumonia in Egyptian infants and children. This cross sectional study was conducted on 50 infants and children from 1 month old up to 5 years old who were admitted in El Galaa Teaching Hospital with clinical and/or radiological diagnosis of pneumonia. Complete Blood Count (CBC), quantitative C-Reactive Protein (CRP), blood culture, sputum culture and X-ray chest were done for all patients. We found that infants less than 1 year old were the most affected by pneumonia (70%) in our study group. Bacterial pneumonia and mixed (bacterial and viral due to respiratory syncytial virus) infections constituted a large proportion among identifiable causes of infections (36% and 12% of patients, respectively) 16 patients (32%) had positive sputum culture and only 9 patients (18%) had positive blood culture results. The most common isolated organism from sputum culture was Haemophilus influenza (16%) while the most common organism from blood culture was Staphylococcus aureus (6%) and only one patient (2%) had mixed growth. We conclude that pneumonia is a common cause of morbidity and mortality among Egyptian infants and children less than 5 years old, especially in the first year of life. Patients with bacterial pneumonia had more severe form of pneumonia. CBC and blood culture results can't be considered dependable tools in identification of etiological causes of pneumonia in infants and children.

Keywords: Community acquired pneumonia, Blood culture, Sputum culture, Bacterial agents, RSV

INTRODUCTION

Pneumonia is a common inflammatory process of alveoli and terminal air spaces. Usually it is due to infectious agents' invasion as viruses, bacteria and other organisms into the lungs through inhalation or hematogenous spread [1]. Pneumonia may occur also due to food or gastric acid, foreign bodies, hydrocarbons and lipoid substances aspiration, hypersensitivity reactions, radiation or induced drug pneumonitis [2].

Still pneumonia is the leading cause of child mortality, in developing countries, researchers estimate that about 150 million new cases occur in children under 5 years annually [3,4]. About 20 million of them severe enough to require hospital stay [5]. World health organization stated that two thirds of deaths due to pneumonia occur in infancy and about 90% occur in developing countries [6].

Normally lung doesn't contain any bacteria because of many effective defense mechanisms that kill or clear bacteria as the properties of normal secretions as secretory immunoglobulin A, mucociliary clearance, air way clearance by coughing and the presence of macrophages in bronchioles and alveoli [2].

The endogenous sources of organisms are either commensalism in nasal mucosa, mouth, sinuses, oropharynx, tracheal tree colonization or hematogenous spread from a specific focus. On the other hand, exogenous agents can gain access to the tracheobronchial tree through circuits and humidifiers [7]. Viral pneumonia occurs usually after direct injury of respiratory epithelium due to spread of infection along the airways.

Occurrences of pneumonia depend on several factors, such as: virulence, quantity of aspirated or inhaled organizes that reach the lower respiratory tract, defense barriers integrity and body immunity status [8].

The aim of our present work is to determine and evaluate the possible etiological agents of pneumonia in Egyptian infants and children.

PATIENTS AND METHODS

This cross sectional study was conducted on 50 infants and children from 1 month up to 5 years old who were admitted in El Galaa Teaching Hospital with clinical and radiological diagnosis of pneumonia during the period from January 2016 till June 2016.

All patients were satisfying the whole criteria of severe and very severe pneumonia [9], and were subjected to: detailed history taking, thorough clinical examinations, laboratory investigations (CBC, quantitative C-reactive protein, arterial blood gases, blood culture, sputum culture, respiratory syncytial virus IgA, IgM and IgG) [10-14] and radiological investigations (plain chest X-ray and CT chest when indicated) to detect different radiological findings of pneumonia and complications as pneumothorax, pleural effusion, empyema, pneumatoceles or lung abscess.

STATISTICAL METHODS

The data were coded and entered using the statistical package SPSS version 19. The data were summarized using descriptive statistics: mean, standard deviation, median, minimal and maximum values for quantitative values. Non parametric Mann-Whitney test was used for quantitative variables and number and percentage for qualitative variables. P-Values less than or equal to 0.05 were considered significant.

RESULTS

Age of patients ranged from 1 month to 60 months with mean age of 13 (± 15.75) months, median age was 5.5 months. 70% of our patients were less than 1 year old, 65% of our patient were males.

Among our patients, the most predominant clinical finding were fever, dyspnea (which were present in all cases) and caught (94% of patient) (Figure 1).

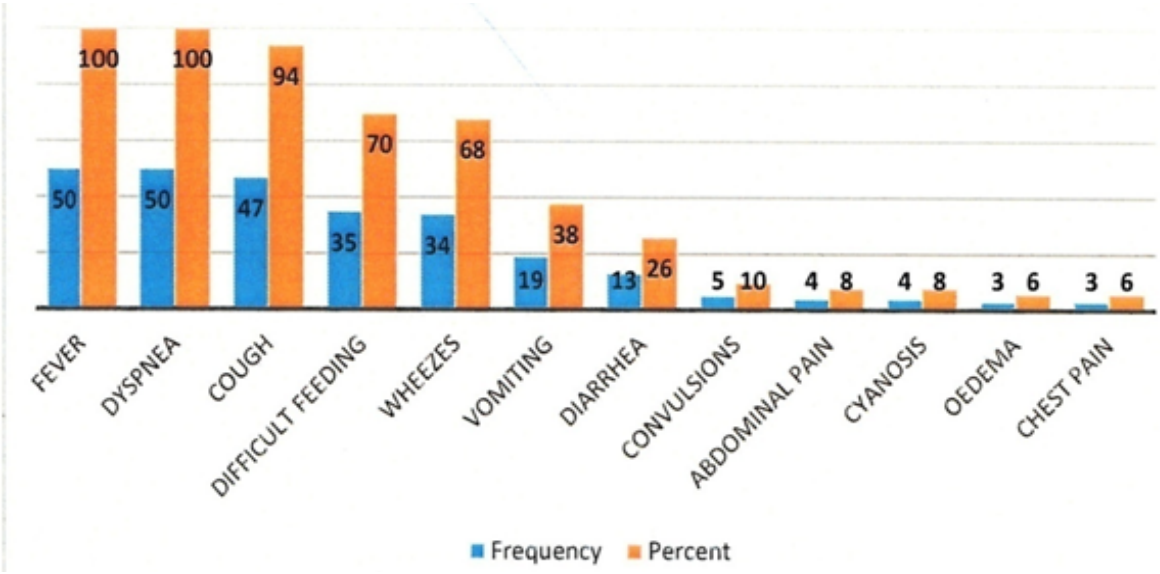

Figure 1: Frequency distribution of different symptoms and signs among the study group (expressed as number and %)

All patients received obligatory vaccines (as measles and DPT), according to schedule and no one received Pneumococcal Conjugate Vaccine (PCV).

Figure 2 shows the frequency distribution of radiological findings among the study group. There was no statistically significant relationship between radiological findings, etiological causes of pneumonia and need for ICU admission.

CRP ranged from 2 to 196 and mean was 62.45 (± 56.35) and median was 44.5 mg/dl. The majority of patients (84%) had positive CRP, with 16 patients (32%) had CRP of >80 mg/L.

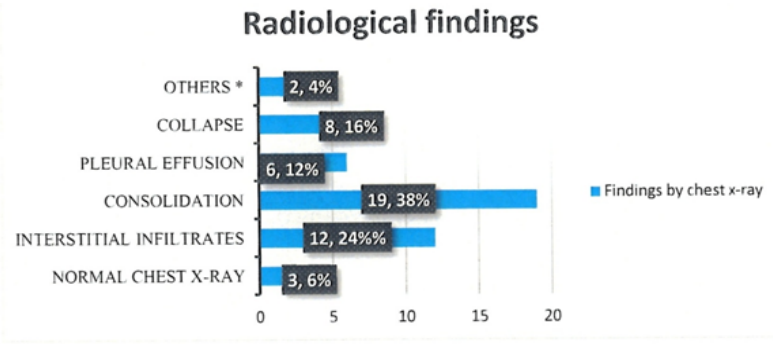

Figure 2: Frequency distribution of radiological findings among the study group (expressed as number and %)

In the study group, 16 patients (32%) had positive sputum culture results and only 9 patients (18%) had positive blood culture results. The most common isolated organisms from sputum culture were *Haemophilus influenza* (16%) followed by *Staphylococcus pneumonia* (10%) (Figure 3), while the most common isolated organisms from blood culture were *Staphylococcus aureus* and coagulase negative staphylococci (CONS) (6% each). As regards blood culture, only one patient (2%) had mixed growth (*S. aureus and enterococci*) (Figure 4).

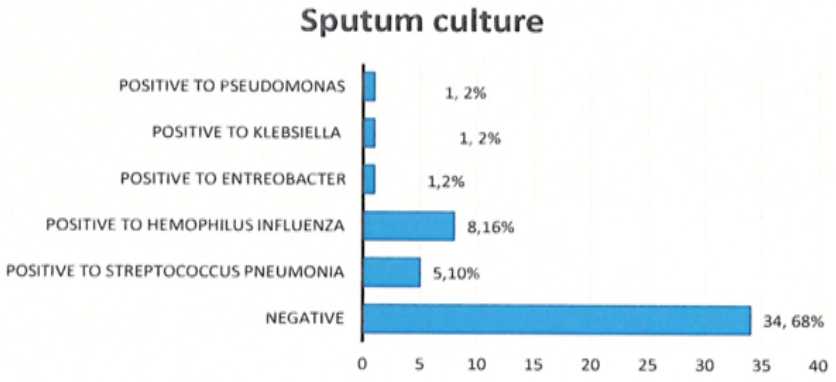

Figure 3: Frequency distribution of sputum culture results in the study group (expressed as number and %)

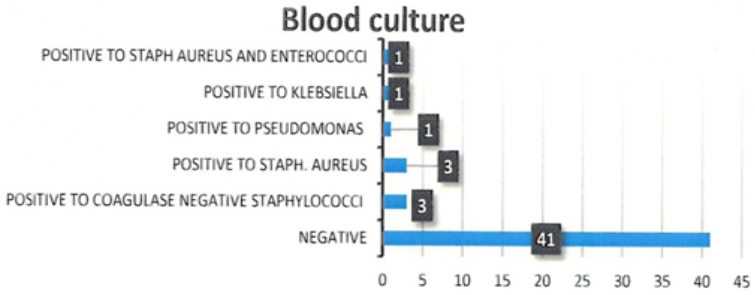

Figure 4: Frequency distribution of blood culture results in the study group (expressed as number and %)

Positive RSV IgM and IgA were present in only 14% and 12% of patients, respectively, while 86% of patients had positive RSV IgG results. By interpretation of these tests, recent RSV infection was detected in only 8 patients (16%) (Table 1).

Table 1: Descriptive analysis of RSV IgA, IgM and IgG levels in blood of patients of the study group

	Minimum	Maximum	Mean	SD	Median
RSV IgM	0.6	110	7.91	17.78	2.2
RSV IgA	0	220	10.46	32.97	1.5
RSV IgG	1.3	729.4	127.22	152.07	63.05

Etiological causes were identified in 52% of patients, bacterial pneumonia was detected in 18 patients (36%), 6 patients (12%) had mixed bacterial and viral infection (RSV) and 2 patients had viral (RSV) infection. One case of the bacterial pneumonia was due to T.B. There was a statistically significant relationship between etiological causes of pneumonia, lymphocytic count, presence of shift to left, CRP of >80 mg/L and complication of pneumonia (p-value is 0.000, 0.000, 0.002 and 0.000, respectively). However there was no statistically significance between etiology of pneumonia, age, radiological findings, grades of fever, respiratory distress grades, hypoxemia, white blood cells, CRP (negative or positive), past RSV infection and need for ICU admission (Table 2).

Table 2: Statistical analysis of etiological causes of pneumonia in relation to different parameters among patients of the study group

		Etiological causes of pneumonia								
		Bacterial pneumonia		Viral pneumonia due to RSV		Mixed bacterial and viral (RSV) infection		Unknown etiology		P value
		n=18	% within group	n=2	% within group	n=6	% within group	n=24	% within group	
Age groups	1-12 months old	11	61.1%	1	50%	4	66.7%	19	79.2%	0.636
	13-24 months old	1	5.6%	0	0%	1	16.7%	2	8.3%	
	25-60 months	6	33.3%	1	50%	1	16.7%	3	12.5%	
Co-morbid diseases	Absent	10	55.6%	1	50%	4	66.7%	16	66.7%	0.869
	Present	8	44.4%	1	50%	2	33.3%	8	33.3%	
Radiological findings	Normal x-ray	0	0%	0	0%	0	0%	3	12.5%	0.248
	Interstitial infiltrates	3	16.7%	1	50%	0	0%	8	33.3%	
	Consolidation	6	33.3%	1	50%	2	33.3%	10	41.7%	
	Collapse	4	22.2%	0	0%	1	16.7%	3	12.5%	
	Pleural effusion	4	22.2%	0	0%	1	16.7%	0	0%	
	Other	1	5.6%	0	0%	1	16.7%	0	0%	
Grades of fever	Mild grade fever	6	33.3%	1	50%	2	33.3%	14	58.3%	0.654
	Moderate grade fever	9	50%	1	50%	3	50%	9	37.5%	
	High grade fever	3	16.7%	0	0%	1	16.7%	1	4.2%	
Respiratory distress grades	RD II	10	55.6%	2	100%	3	50%	18	75%	0.206
	RD III	7	38.9%	0	0%	1	16.7%	5	20.8%	
	RD IV	1	5.6%	0	0%	2	33.3%	1	4.2%	
Hypoxemia	Absent	3	16.7%	1	50%	2	33.3%	13	54.2%	0.097
	Present	15	83.3%	1	50%	4	66.7%	11	45.8%	
White blood cells	Normal White blood cells	11	61.1%	2	100%	3	50%	22	91.7%	0.057
	Leucocytosis	7	38.9%/	0	0%	3	50%	1	4.2%	
	Leucopenia	0	0%	0	0%	0	0%	1	4.2%	
Lymphocytic count	Normal Lymphocytic count	2	11.1%	0	0%	1	16.7%	16	66.7%	0.000
	Lymphocytosis	0	0%	2	100%	3	50%	2	8.3%	
	Lymphocytopenia	16	88.9%	0	0%	2	33.3%	6	25%	
Shift to left	Absent	1	5.6%	2	100%	1	16.7%	19	79.2%	0.000
	Present	17	94.4%	0	0%	5	83.3%	5	20.8%	
CRP	Negative	1	5.6%	1	50%	0	0%	6	25%	0.123
	Positive	17	94.4%	1	50%	6	100%	18	75%	
CRP	>80 mg/l	7	38.9%	2	100%	3	50%	22	91.7%	0.002
	<80 mg/l	11	61.1%	0	0%	3	50%	2	8.3%	
Past RSV infection	Negative	2	11.1%	0	0%	1	16.7%	4	16.7%	0.890
	Positive	16	88.9%	2	100%	5	83.3%	20	83.3%	
Need for ICU admission	Not needed	10	55.6%	2	100%	4	66.7%	18	75%	0.429
	Needed	8	44.4%	0	0%	2	33.3%	6	25%	
Complications	Absent	3	16.7%	2	100%	0	0%	17	70.8%	0.000
	Present	15	83.3%	0	0%	6	100%	7	29.2%	

In the study group, 28 patients (56%) were complicated and the most common complications occurred were pulmonary complications (36%). Only 6 patients (12%) had recurrent pneumonia. Pulmonary complications included: collapse, lung abscess, pleural effusion, pneumatoceles, pneumothorax and respiratory failure. Extra pulmonary complications (2.4%) included bactermia and septic shock, while both pulmonary and extra pulmonary complications were (9.18%). About one third of patients (33.3%) needed ICU admission.

DISCUSSION

Pneumonia accounts for about 18% of deaths per year in children fewer than 5 years of age. The WHO estimates that two thirds of

deaths due to pneumonia occur during infancy and more than 90% occur in developing countries [15,16]. The explanations for the high percentage in developing countries include overcrowding, malnutrition, low birth weight and limited access to health services [17].

In our study, 70% of our patients were under 1 year old, 8% were 1-2 years while 22% were between 2-5 years. This in an agreement with the studies of Sadoh and Osarogiagbon, Mustapha et al., and Asih et al., who reported that 74.38%, 57.3% and 66.9%, respectively, of their patients were less than 1 year [17-19]. This can be attributed to their under developed immune system, defective humoral immunity and the nature of their respiratory tract with its small caliber and defective immune defenses [20].

Concerning CRP, it was positive in 84% of cases and the mean was 62.45 (± 56.35) this was in agreement with Asih et al., and Bisquera-Cacoal et al., who found that CRP was positive in complicated and uncomplicated pneumonia [19,21].

Thirty two percent of our patients had positive sputum, pleural fluid or endotracheal aspirate cultures. The most commonly isolated organisms were *H. influenza* (16%), *S. pneumonia* (10%), enterobacter (2%), klebsiella (2%) and pseudomonas (2%). As compared to Bisquera–Cacoal et al., they found that 23.1% of their patents had positive sputum cultures results. However, they reported that the organisms isolated from those cultures were *S. aureus* and pseudomonas, while no *S. pneumonia* was isolated. On the other hand Hortal et al., found that *S. pneumonia* isolates were identified in 4.3% of cultures [22].

The frequency of positive bacterial growth from blood culture among our patients was 18%. In agreement with our study, Baltimore, stated that 20% of children with pneumonia have positive blood culture and this rate increases to 30-40% of patients with paraneumonic effusion or empyema [23]. Also, Myers et al., found 7.1% of their patients with bacteremia which increased to 21% in patients with pleural effusion and to 75% in patients with distant site of infection [24].

Moreover, Shah et al., found that positive blood cultures was present in 2.1% of patients and this rate increased in complicated (7.8%) than in uncomplicated cases (0.8%) [25].

The most frequently isolated organism from blood culture was coagulase negative staphylococci (6%), *S. aureus* (6%), and followed by pseudomonas and klebsiella (2% each). Mixed growth was present in 2% of patients (*S. aureus* and enterococci). Neither *S. pneumonia* nor *H. infuenza* was isolated from blood cultures in our study, despite being the most common causes of bacterial pneumonia on infant and children. Similar to our results, Nascimento–Carvalho et al., in a Brazilian study, found that pneumococcus were recovered from only 0.8% of blood cultures [26]. Also Harris et al. and Michelow et al. didn't isolate it from hospitalized children with CAP [27,28].

Possible explanations of low yield of sputum and blood cultures are likely due to the widespread and inappropriate use of antibiotics especially when it has been administered previously.

RSV infection was detected in 16% of our cases, Okiro et al., found similar results and reported that, among 2413 children tested for RSV, 12% of children with acute lower respiratory tract infection were RSV positive [29].

Eight six percent of infants and children in our study group were RSV IgG positive. Similar to our results Chakavarti and Kashyap, reported that 70.8% of their cases had RSV infection [30]. Iwan et al., stated that almost all children will be infected with RSV by their second year of life [31].

Regarding etiological causes of pneumonia, 36% of our patients had bacterial pneumonia, 4% were viral (due to RSV), 12% had mixed (bacterial and RSV) pneumonia, and 48% were of unknown etiology. In agreement with our results, Temleton et al. stated that it is not always possible to define the causative pathogen, and even with sophisticated techniques 25-33% of cases of pneumonia worldwide are not attributed to any pathogen [32]. In the American study of Michelow et al., they reported that typical bacteria were found in 26% of patients, Mycoplasma and Chlamydia pneumonia in 11%, viral pneumonia occurred in 19%, mixed (bacterial and viral) infections were found in 23% of cases and 21% had pneumonia with unknown etiology [28].

CONCLUSION

Pneumonia is a common cause of morbidity and mortality among Egyptian infant and children less than 5 years old, especially in the first year of life. Bacterial and mixed (bacterial and viral) pneumonia constituted a large proportion among identifiable causes of infection. Radio graphic findings, CBC, sputum and blood cultures results cannot be considered dependable tools in identification of etiological causes or prognosis of pneumonia in infants and children.

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REFERENCES

[1] R. Shyamala, J. Rao, *J. Microbiol. Biotech. Res.,* **2014**, (1), 7-10.

[2] T.C. Sectish, C.G. Prober, **2007**, 297, 1795-1800.

[3] I. Rudan, K.L. O'Brien, H. Nair, L. Liu, E. Theodoratou, *J. Global. Health.,* **2013**, 3(1), 010-401.

[4] L. Liu, H.L. Johnson, S. Cousen, J. Perin, S. Scott, *Lancet.,* **2012**, 379(9832), 2151-2161.
[5] I. Rudan, B. Pintoc, Z. Biloglav, K. Mulhalland, H. Cambell, *Bull. World. Health. Organ.,* **2008**, 86(5), 406-416.
[6] K. Tiewsoh, R. Lodha, R.M. Pandey, S. Broor, M. Kalaivani, *BMC. Pediatrics*., **2009**, 9(1), 15.
[7] K. Brown, **2002**, 219-225.
[8] Y.D. Singh, *Curr. Opin. Pulm. Med*., **2005**, 11(3), 218-225.
[9] M.K. Mwaniki, D.J. Nokes, J. Ignas, P. Munywoki, M. Ngama, **2009**, 87(4), 263-270.
[10] World Health Organization. WHO, Geneva, Switzerland. **2011**, 3, 1-6.
[11] P. Chiarello, M. Magnolia, M. Rubino, S.A. liguori, R. Miniero, *Minerva. Pediatrica.,* **2011**, 63(6), 507-513.
[12] B.F. Rodale, **2002**, Philadelphia, W.B. Saunders Co. (Last accessed on April 20, **2015**).
[13] M.S. Barthwal, *J. Assoc. Phys. India.,* **2004**, 52, 573-577.
[14] J.G. Collee, *J. Clinical. Pathol.,* **1984**, 37(11), 1319.
[15] D.M. Gray, H.J. Zar, *Curr. Opin. Pulm. Med.,* **2010**, 16(3), 208-216.
[16] S. Jain, D.J. Williams, S.R. Arnold, K. Ampofo, A.M. Bramley, *J. Med.,* **2015**, 372 (9), 835-845.
[17] M.G. Mustapha, G.M. Ashir, M.A. Alhaji, A.I. Rabasa, B.A. Ibrahim, *Nigeria. J. Pediatrics.,* **2013**, 40(1), 30-33.
[18] W.E. Sadoh, W.O. Osarogibon, *Afr. Health. Sci.,* **2013**, 13(3), 607-612.
[19] R. Asih, Z. Aini, *Indonesian. J. Trop. Infect. Dis.,* **2011**, 2(1), 34-37.
[20] J.S. Abramson, **2007**, 181, 1130-1135.
[21] J. Bisquera-Cacoal, J.D. Gutierrez, R.D. Garcia, *PIDSP. J.,* **2010**, 11(2).
[22] M. Hortal, M. Estevan, I. Iraola, B. De Mucio, *Int. J. infect. Dis.,* **2007**, 11(3), 273-277.
[23] R.S. Baltimore, H.B. Jenson, R.S. Baltimore, 2nd ed, **2002**, 832, WB Saunders, Philadelphia.
[24] A.L. Myers, M. Hall, D.J. Williams, K. Auger, J.S. Tieder, *Pediatr. Infect. Dis. J.,* **2013**, 32(7), 736-740.
[25] S.S. Shan, M.H. Dugan, L.M. Bell, R.W. Grundmeier, T.A. Florin, E.M. Hines, J.P. Metlay, *Pediatr. Infect. Dis. J*., **2011**, 30(6), 475.
[26] C.C. Nascimento, A.A. Lopes, M.D. Gomes, M.P. Magalhaes, J.R. Oliveiro, *J. Infect. Dis.,* **2001**, 5(1), 13-20.
[27] A.M. Harris, F. Sempertegui, B. Estrella, J. EgasEnviron, *Health*., **2011**, 10(93), 10-1186.
[28] I.C. Michelow, K. Olsen, J. Lozano, N.K. Rollins, L.B. Duffy, *Pediatrics*., **2004**, 113(4), 701-707.
[29] E.A. Okiro, M. Ngama, A. Bett, D.J. Nokes, *PLOS ONE*. **2012**, 7(12), e52520.
[30] A. Chakravati, B. Kashyap, *Iranian. J. Pediat.,* **2007**, 17(2), 123-128.
[31] M.K. Iwan, E.C. Farnon, S.I. Gerber, *The J. Infect. Dis.,* **2013**, 208(s3), s 165-66.
[32] K.E. Templeton, S.A. Schelting, W.C. Vanden Eeden, W.A. Graffelman, P.J. Vanden Broken, *Clin. Infect. Dis.,* **2005**, 41(3), 345-351.