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REVIEW: PEDIATRIC PNEUMONIA, ETIOLOGY, DIAGNOSIS AND MANAGEMENT

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Abstract:

This review focuses on pneumonia in children, specially the most popular one community acquired pneumonia (CAP), its etiology, various diagnostic methods and treatment approaches. Following databases; Medline/PubMed, and Embase and Google scholar were comprehensively searched for articles that are concerned with etiology, diagnosis and management of Pediatric pneumonia, etiology, diagnosis and management, which published up to beginning of, 2020 with English language, and involving only human subject. Pneumonia is an inflammatory reaction of the lungs triggered by bacteria, viruses, or chemical toxic irritants. It is a major infection or inflammation in which the air sacs loaded with pus and also various other liquid. Medical diagnosis is normally made based upon the period and also the level of the illness. Based on these aspects, medical care provider may diagnose merely on a comprehensive history and health examination, but may consist of the following testing to verify the medical diagnosis. The combination of fever and also cough is suggestive for pneumonia; various other respiratory results (eg, tachypnea, boosted work of breathing) might precede the cough. Cough may not be an attribute originally since the alveoli have only a few cough receptors. Cough begins when the products of infection irritate cough receptors in the air passages. The longer fever, cough, and respiratory findings exist, the higher the likelihood of pneumonia.

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INTRODUCTION:

Pneumonia is an inflammatory reaction in a single or either of the lungs that is frequently triggered by a viral or bacterial being infected [1]. The inflammation hinders the body's capability to supply oxygen and eliminate carbon dioxide from the blood [1].

Pneumonia is utmost killer of youngsters around the world, with 920136 deaths in youngsters in 2015 [2]. Even though less lethal in developing countries like the United States, the burden is still considerable, with annual ambulatory visit rates for community acquired pneumonia (CAP) in US kids of 16.9 to 22.4 per 1000 in the population [3]. In North America, pneumonia is also a usual source of childhood years morbidity and also occasionally mortality [4]. A research from Israel has actually likewise revealed that there can be considerable economic burdens to youngsters and households managing community acquired pneumonia, along with considerable decrease in their quality of life [5]. Symptoms of pediatric pneumonia depend upon the cause of the infection as well as several other elements, consisting of the age and also general wellness of the kid. Fast respiration, a high temperature as well as coughing are three of the most common indications of the problem [6].
Traditionally, doctors, having formulated a differential diagnosis from a constellation of medical signs and symptoms, will make use of diagnostic tests to establish illness etiology. Nevertheless, the diagnostic difficulty of childhood CAP lies in the broad variety of presenting attributes as well as the lack of an approved gold criterion diagnostic test. In addition, the diversified age array within pediatric practice includes in this challenge differences in immune advancement and also vaccination status and dependence on caregivers for detailed patient backgrounds.

Pneumonia is generally encountered by emergency unit as well as primary care medical professionals. Childhood pneumonia remains a considerable cause of morbidity as well as death, whereas fatality percentages in the developed globe have reduced secondary to new vaccines, antibiotics, and also advances in diagnostic and monitoring methods. This review focuses on pneumonia in children, specially the most popular one – CAP, its etiology, various diagnostic methods and treatment approaches.

METHODOLOGY:

Following databases; Medline/PubMed, and Embase and Google scholar were comprehensively searched for articles that are concerned with etiology, diagnosis and management of Pediatric pneumonia, etiology, diagnosis and management, which published up to beginning of, 2020 with English language, and involving only human subject. After all we manually screened the references list of each included articles for more relevant studies to our current review.

DISCUSSION:

- **CLASSIFICATION OF DISEASE**

Pneumonias are categorized by location of obtainment, by reason, by area of lung impacted, and also
after that finally as well as most commonly utilized in the pediatric age, by the extent [6].

- ***By Location of acquisition.***

Pneumonia can also be identified conceding to where or how it was obtained.

Hospital-acquired pneumonia (HAP)

Pneumonia makes difficult hospitalization in 0.5 to 2.0% of patients as well as is connected with substantial morbidity and mortality [9]. It is been located to lengthen hospital stays by 1-2 weeks [10]. Hospital-acquired pneumonia (HAP) additionally referred to as nosocomial pneumonia describes any type of pneumonia acquired by a patient in a health center a minimum of 48- 72 hrs after being accepted. The isolated pathogens are usually multidrug-resistant and the mortality percentage remains high if appropriate interventions are not instituted.

It is the 2nd most common nosocomial infection (after urinary system infections) as well as represent 15- 20% of the total hospital acquired infections [10]. It is one of the most typical cause of death among. nosocomial infections and also is the key cause of fatality in critical care unit [10].

Community-acquired pneumonia (CAP)

CAP is the type that occurs in persons residing in a community who have little contact with the medical care system. It is among the most usual infectious diseases, and a substantial source of morbidity and mortality worldwide [7]. Over a hundred pathogens can cause CAP. One of the most common microorganism types differ among different categories of individuals [8].

Generally, one of the most substantial pathogens: Streptococcus pneumoniae, Haemophilus influenzae, and Moraxella catarrhalis, account for around 85% of CAP cases [7]. It is interesting to keep in mind that at the extremely extremes of life, the sequence of microorganism's changes substantially. Streptococcus agalactiae, also called Group B Streptococcus (GBS), causes > 50% of situations of CAP in the initial week of neonatal life [7],[8]. CAP is normally acquired via inhalation or aspiration of pulmonary pathogenic organisms right into a lung,

which explains to a big degree the pathogens associated with.
disease etiology.
Aspiration pneumonia is the only kind of CAP caused by multiple pathogens.

- ***By cause.***

Aspiration pneumonia
Aspiration pneumonia takes place when you inhale bacteria right into your lungs from food, beverage, or saliva. This type is more likely to take place if you have an ingesting trouble or if too sedate from using drugs, alcohol, or various other medicines.

- ***By area of lung affected.***

Lobar pneumonia
This type of pneumonia only entails a solitary lobe, or section, of a lung.
Bronchopneumonia
Bronchial pneumonia affects the lungs in patches around the tubes (bronchi or bronchioles).
Interstitial pneumonia
Interstitial pneumonia entails the areas in between the alveoli, and it may be called interstitial pneumonitis. It is most likely to be triggered by viruses or by atypical bacteria.

- ***By severity.***

This classification was established by the WHO † in answer to the significant varieties of children with signs of pneumonia (≈ 46%) that never get appropriate treatment. The purpose is to apply easy medical indicators to make a diagnosis, especially in information- constricted settings, and after that use the proper therapy [11].

No pneumonia
This stands for kids with coughing and cold that do not have symptoms of pneumonia. Caregivers are, by the WHO suggestions, recommended on suitable house care.

Pneumonia
Children with rapid breathing are identified as having "pneumonia" and are offered an oral antibiotic to take in your home for a number of days.
Severe pneumonia
Children that had chest in-drawing with or without rapid breathing are categorized as having " serious pneumonia" and also are described the closest health facility for treatment with injectable anti-biotics.

Severe pneumonia or very severe condition
Children who have any general danger signs are classified as having "severe pneumonia or very severe illness". These kids are given a initial dosage of oral antibiotic and are after that urgently referred to a health facility for more assessment as well as therapy with parenteral anti-biotics.

- **ETIOLOGY OF DISEASE**

A multitude of microorganism's trigger pneumonia, ranging from viruses to bacteria as well as fungi (Table 1). The etiologic representatives of pneumonia depend on the individual's age. Respiratory viruses are often the source of pneumonia. Viral pneumonia is normally milder and also can improve in one to 3 weeks without treatment. Fungis from ground or bird excrement can trigger pneumonia. They usually create pneumonia in people with vulnerable body immune systems.

Community-associated methicillin-resistant Staphylococcus aureus (CA-MRSA) must be taken into consideration in situations of challenging pneumonia with empyema as well as necrosis. The latter can be extreme when related to influenza infection. In the last couple of years, clinicians have experienced extreme additional microbial infections after flu infection. This mechanism is still unclear; however, animal versions suggest that flu An improves transmission of microorganisms such as S aureus [12]. Jain et alia (2015) conducted active population-based surveillance for community acquired pneumonia in health centers in 3 American cities [13]. 87% of the 1272 children ages 19 months to 12 years had actually obtained 3 or even more dosages of pneumococcal conjugate vaccination. Of 2222 children with radiographic confirmation of pneumonia as well as laboratory workup, 8% had M. pneumoniae separated and 4% had actually S. pneumoniae isolated. M. pneumoniae was more usual amongst children 5 years of age (19%) or older than among more youthful kids (3%). Yearly incidence of a hospital stay with pneumonia was 15.7 cases per 10 000 kids. When looking at approximated annual incidence of specific pathogens, M. pneumoniae 1.4 per 10 000 and S. pneumoniae 0.5 per 10 000 [13].

Table 1. Pathogens behind the disease.

Bacterial pneumonia	Viral pneumonia	Fungal pneumonia
Group B streptococcus	Respiratory syncytial virus (RSV)	Pneumocystis jirovecii
Staphylococcus aureus	Influenza	Cryptococcus species
Group A streptococcus	Parainfluenza virus	Histoplasmosis species
Mycoplasma pneumoniae.	Rhinovirus	
Haemophilus influenzae	Adenovirus	
Legionella pneumophila	Human Metapneumovirus	
	Enterovirus	
	Coronavirus	
	Herpes simplex virus	

Table 2. Etiologic agents grouped by age of the patient [14].

Age group	Frequent Pathogens (In order of frequency)
Neonates (<3 wk.)	Group B streptococcus, Escherichia coli, other gram- negative bacilli, Streptococcus pneumoniae, Haemophilus influenzae (type b, nontaxable*)
3 wk. – 3 mo.	Respiratory syncytial virus, other respiratory viruses (parainfluenza viruses, influenza viruses, adenovirus), S. pneumoniae, H. influenzae (type b,* nontypable); if patient is afebrile, consider Chlamydia trachomatis
4 mo. – 4 yr.	Respiratory syncytial virus, other respiratory viruses (parainfluenza viruses, influenza viruses, adenovirus), S. pneumoniae, H. influenzae (type b,* nontypable), Mycoplasma pneumoniae, group A streptococcus
≥5 yrs.	M. pneumoniae, S. pneumoniae, Chlamydophila pneumoniae, H. influenzae (type b,*nontypable), influenza viruses, adenovirus, other respiratory viruses, Legionella pneumophila

- **DIAGNOSIS**

Clinical manifestations.

The medical symptoms of pneumonia are diverse. Community-acquired pneumonia has actually classically been characterized by unexpected onset of fever, tachypnea and cough. These signs are frequently preceded by a fairly minor upper respiratory system infection identified by low grade fever as well as rhinorrhea. It is often challenging to differentiate medically children with viral pneumonia from those with bacterial disease. The symptomatology of community-acquired pneumonia in youngsters has not been methodically researched. Numerous children seek medical focus without certain breathing signs and several might show up just gently ill [15]. Tachypnea accompanied by crackles (i.e. rales) on auscultation recommends the diagnosis of pneumonia, even though rales are often not heard in kids with pneumonia, particularly if the kid is dehydrated. Wheezing can be discovered in kids with viral or mycoplasmal pneumonia [15]. Ruuskanen as well as Mertsola note that visibility of tachypnea might be the best means to differentiate a lower respiratory tract infection from an upper respiratory tract infection [15]. Standards developed by the World Health Organization (WHO) for clinical medical diagnosis of pneumonia in the developing globe have emphasized tachypnea and retractions as the very best signs [16]. The WHO specifies tachypnea as > 50 breaths/min in infants less than 1 year of age and also > 40 breaths/min in youngsters 1 year or older. Tachypnea is additionally an indication of asthma or bronchiolitis.

Radiographic imaging

In a kid with moderate lower respiratory signs and symptoms constant with CAP who is a candidate for outpatient therapy, chest radiographs are not consistently needed to make the diagnosis [17]. The visibility of infiltrates on chest radiograph in a child with fever and also respiratory distress confirms the medical diagnosis of pneumonia; nonetheless, the absence of chest x-ray findings does not rule out pneumonia if there is high scientific suspicion. This results from a number of aspects: the radiographic searchings for might hang back the clinical image, dehydrated children might not have an infiltrate initially, and it is impossible to separate atelectasis from pneumonia on a single breast radiograph (an infiltrate that settles in less than 48-72 hrs is more likely atelectasis than pneumonia).

Follow-up chest radiographs are not consistently suggested in children that are properly treated and recuperated. Follow-up radiographs are indicated in complex pneumonias that are medically unstable, in patients receiving sufficient antibiotic protection for 48 to 72 hrs with bad professional renovation or worsening, and in persistent pneumonias that involve the exact same lobe to eliminate a presumed anomaly, chest mass, or foreign body.

Chest ultrasound is most often utilized for examining local difficulties, such as parapneumonic effusion as well as empyema, however recent research studies have actually shown high level of sensitivity (92%-98%) and specificity (92%-100%) for identifying lung consolidation compared to chest radiography [18]. Supplementary benefits of chest ultrasound include an absence of ionizing radiation and availability in most emergency division setups.

Bedside ultrasonography of the chest was researched and compared to chest radiographs. In one prospective cohort research study of 200 individuals, ultrasonography had an overall level of sensitivity of 86% and also a specificity of 89%. The publishers concluded that bedside ultrasonography was found to be a highly specific, noninvasive, radiation-free test that can be made use of by medical professionals to identify pneumonia [18].

Blood cultures

The 2011 PIDS/IDSA CAP instruction advises acquiring blood cultures in kids hospitalized with CAP [20]. In this setup, nonetheless, blood cultures determine a pathogen in just 2% to 7% of kids with CAP [20]. Blood cultures are regularly positive in youngsters with parapneumonic effusion, ranging from 10% to 35% [19]. In the outpatient setting, blood cultures are not consistently recommended, due to the fact that positivity percentages are reduced and also outcomes are unlikely to modify management. Nonetheless, despite their low yield, blood cultures currently supply the most effective opportunity to identify typical bacterial microorganisms in the majority of youngsters with CAP. In a review of European pediatric studies, Ruuskanen and also Mertsola found that, depending on the degree of research laboratory screening carried out, the microbial reason for pneumonia could be determined in 20 to 60% of instances [15].

Other methods of diagnosis:

- Sputum Gram Stain and Culture
- Urinary Antigen Detection Tests
- Complete Blood Cell Count
- Pulse Oximetry
- Procalcitonin (PCT)
- C-reactive protein (CRP)
- Nasopharyngeal samples
- Respiratory viral studies
- Bronchoscopic or blind protected specimen brush sampling
- Percutaneous lung aspiration
- Open lung biopsy

Making use of blood inflammatory biomarkers to distinguish bacterial from viral CAP has actually been investigated. Procalcitonin (PCT) and C-reactive protein (CRP) have actually revealed some value in the recognition of microbial infections, but it has not been developed yet an appropriate medical cut-off factor for their usage [21].

- **TREATMENT**

Treatment needs to be intended to a certain virus that is assumed based upon information obtained from history as well as physical exam. Encouraging and symptomatic monitoring is key and also consists of additional oxygen for hypoxia, antipyretics for fever, and also liquids for dehydration. This is specifically important for non-infectious pneumonitis and viral pneumonia for which anti-biotics are not shown [22]. Coughing suppressants are not advised.

Most of kids identified with pneumonia in the outpatient setup are managed with oral anti-biotics. High-dose amoxicillin is made use of as a first-line agent for kids with uncomplicated community-acquired pneumonia. Second- or third-generation cephalosporins and macrolide antibiotics such as azithromycin serve alternatives [28]. Mix treatment (ampicillin and either gentamicin or cefotaxime) is commonly used in the initial therapy of infants and young babies.

Three studies released in the past 6 years contrasted the efficacy of conventional therapy with medications such as amoxicillin or amoxicillin/clavulanate keeping that of newer macrolides such as azithromycin and clarithromycin [23-25]. The outcomes show comparable efficiency amongst treatments, all of which produced superb clinical treatment rates. For instance, Wubbel et al. discovered that 143 of 147 individuals treated with azithromycin, erythromycin estolate or amoxicillin/clavulanate were categorized as being medically healed [23].

Manfredi et al compared azithromycin for 3-5 days with erythromycin for 7 days as well as identified no difference in effectiveness, Block et al compared erythromycin with clarithromycin, each provided for 10 days, as well as also identified no distinctions in efficiency, and also Ficnar et alia contrasted a 3 day course of azithromycin with a 5 day course and showed no difference between the two therapy teams [26-28].

A methodical review published in 2016 evaluated all randomized clinical tests, released till April 2015, where kids with CAP were treated with anti-biotics and also followed : 54 studies were consisted of, out of which, 13 evaluated the efficacy of amoxicillin in non-severe non-hospitalized patients and 8 examined the effectiveness of amoxicillin in hospitalized individuals [29] Hence, amoxicillin was one of the most researched antimicrobial, with the very best technical strategy and also the most efficient confirmation.

Incredibly, the WHO significantly modified its referral in 2012: for kids with fast breathing and hissing, but no breast indrawing, danger signs, neither fever(<38◦C), anti-biotics ought to not regularly be suggested, as the cause is probably viral infection [30]. In the developig world, for pediatric patients with nonsevere pneumonia (as defined by WHO), a pulse oximetric SpO_2 measurement of 90 % at the initial has actually been documented to be predictive of failure of outpatient oral amoxicillin therapy [32]. ICU-level treatment is not generally required for children with CAP. Nevertheless, in a research from Dallas, Texas, 6.5 % of children hospitalized with CAP called for mechanical ventilation, and also 1.3 % of youngsters with CAP passed away, although almost one-third had actually comorbid problems [31]. An increased percentage of those with mixed bacterial as well as viral infections needed mechanical ventilation (8.3 %); death was 5.6 % in this subgroup of children hospitalized with CAP [31]. Hospitalized patients can likewise usually be managed with a narrow-spectrum penicillin such as ampicillin. The choice of representative and dosing may vary based on local resistance rates. In regions where resistance is really high (> 25 % of strains being no susceptible), a third-generation cephalosporin might be shown instead [28]. Older kids, furthermore, might obtain a macrolide to deal with atypical infections. It is very important to have a high index of cautiousness for complications, especially in individuals returning for repeat examination (Table 3).

Table 3. Complications associated with CAP [33].

Pulmonary: Pleural effusion or empyema Pneumothorax Lung abscess Bronchopleural fistula Necrotizing pneumonia Acute respiratory failure
Metastatic: Meningitis Central nervous system abscess Pericarditis Endocarditis Osteomyelitis Septic arthritis
Systemic: Systemic inflammatory response syndrome or sepsis Hemolytic uremic syndrome

Neonates and also babies more youthful than 90 days old ought to be hospitalized for therapy, in addition to children that are immunocompromised or have other underlying persistent illnesses like sickle cell anemia or cystic fibrosis [22]. Children with social factors that preclude access to care, have actually failed outpatient treatment, or present with presumed tuberculosis, need to also be hospitalized [22].

Aside from staying clear of transmittable contacts, vaccination is the main mode of avoidance. Influenza vaccination is suggested for children aged 6 months and older. The pneumococcal conjugate vaccine (PCV13) is suggested for all kids younger than 59 months old. The 23-valent polysaccharide vaccination (PPV23) is recommended for children 24 months or older who are at high threat of pneumococcal disease.

Table 4. Empiric Antibiotic Regimen [28].

Outpatient	**Inpatient**
First line:	***First line:***
• Young children:	Ampicillin
Amoxicillin	Cephalosporin
• Adolescent:	Azithromycin
Azithromycin	***Second line:***
Second line (adolescent):	Vancomycin
Macrolide or doxycycline	Clindamycin
Fluoroquinolones (eg, levofloxacin, moxifloxacin) – Also used for adolescent or older child with type 1 hypersensitivity to b-lactam antibiotics	Linezolid

CONCLUSION:

Pneumonia is an inflammatory reaction of the lungs triggered by bacteria, viruses, or chemical toxic irritants. It is a major infection or inflammation in which the air sacs loaded with pus and also various other liquid.

Medical diagnosis is normally made based upon the period and also the level of the illness. Based on these aspects, medical care provider may diagnose merely on a comprehensive history and health examination, but may consist of the following testing to verify the medical diagnosis.

The combination of fever and also cough is suggestive for pneumonia; various other respiratory results (eg, tachypnea, boosted work of breathing) might precede the cough. Cough may not be an attribute originally since the alveoli have only a few cough receptors. Cough begins when the products of infection irritate cough receptors in the air passages. The longer fever, cough, and respiratory findings exist, the higher the likelihood of pneumonia.

Neonates as well as young babies might provide with trouble feeding, uneasiness, or fussiness instead of with cough and/or irregular breath noises. Neonates, young infants, and also children (ie, <5 to 10 years old) may provide only with fever and leukocytosis.

Medical diagnosis is generally based on a physical examination and numerous other examinations, which may include blood tests as well as an X-ray. The prognosis for pediatric pneumonia is generally excellent. A bacterial infection can commonly be managed with antibiotics, such as amoxicillin. Viral pneumonia generally settles on its own without the requirement for medicine. Nevertheless, parents and also guardians need to be vigilant, as the condition is often tough to find in children. A lot of fatalities from pediatric pneumonia occur as a result of underlying wellness problems, such as heart problem.

Vaccination against microbial infection is the very best way of preventing the spread of pediatric pneumonia. Youngsters matured over six months old may additionally take advantage of the influenza vaccination.

REFERENCES:

1. "Childhood Pneumonia." JAMA Network. 01 August, 2017.
2. World Health Organization. Pneumonia. 2016. Available at: www.who.int/ mediacentre/factsheets/fs331/en/ index.html.
3. Kronman MP, Hersh AL, Feng R, Huang YS, Lee GE, Shah SS. Ambulatory visit rates and antibiotic prescribing for children with pneumonia, 1994–2007. Pediatrics. 2011;127(3):411–418.
4. McIntosh K (2002) Community-acquired pneumonia in children. N Engl J Med 346: 429–437.
5. Shoham Y, Dagan R, Givon-Lavi N, Liss Z, Shagan T, et al. (2005) Community-acquired pneumonia in children: quantifying the burden on patients and their families including decrease in quality of life. Pediatrics 115: 1213–1219.
6. LizDunn. Pneumonia: classification, diagnosis and nursing management. Nurs.Stand. 19, 50–54 (2005).
7. Community-Acquired Pneumonia. (2015). At <http://emedicine.medscape.com/article/234240-overview#aw2aab6b2>
8. Community-acquired pneumonia. Wikipedia, the free encyclopedia (2015). At <http://en.wikipedia.org/w/index.php?title=Community-acquired_pneumonia&oldid=656766081>
9. Lynch, I., Joseph P. Hospital-acquired pneumonia*: Risk factors, microbiology,and treatment. Chest 119, 373S–384S (2001).
10. Longo, D. et al. Harrison's Principles of Internal Medicine, 18th Edition. (McGraw-Hill Education, 2011). at http://books.google.com.gh/books?id=7gxjMV8hClsC
11. Revised WHO Classification and Treatment of Pneumonia in Children at Health Facilities. (2014). at http://www.ncbi.nlm.nih.gov/books/NBK264162/
12. Prayle A, Atkinson M, Smyth A. Pneumonia in the developed world. Paediatr Respir Rev. 2011;12(1):60–69.
13. Jain S, Williams DJ, Arnold SR, Ampofo K, Bramley AM, Reed C, et al. Community-acquired pneumonia requiring hospitalization among U.S. children. N Engl J Med. 2015;372(9):835-45.
14. Kliegman, R. Nelson Textbook of Pediatrics. (Elsevier/Saunders, 2011). At https://books.google.com.gh/books?id=TsBtpwAACAAJ
15. Ruuskanen O, Mertsola J. Childhood community-acquired pneumonia. Semin Respir Infect 1999;14:163–72.
16. The WHO Young Infants Study Group. Serious infections in young infants in developing countries: rationale for a multicenter study. Pediatr Infect Dis J 1999;18(10 Suppl):S4–7.
17. Bradley JS, Byington CL, Shah SS, et al; Pediatric Infectious Diseases Society and the Infectious Diseases Society of America. Executive summary: the management of community-acquired pneumonia in infants and children older than 3 months of age: clinical practice guidelines by the Pediatric Infectious

Diseases Society and the Infectious Diseases Society of America. Clin Infect Dis. 2011;53(7):617–630.
18. Shah VP, Tunik MG, Tsung JW. Prospective evaluation of point-of-care ultrasonography for the diagnosis of pneumonia in children and young adults. JAMA Pediatr. 2013;167(2): 119–125.
19. Myers AL, Hall M, Williams DJ, et al. Prevalence of bacteremia in hospitalized pediatric patients with community-acquired pneumonia. Pediatr Infect Dis J. 2013;32(7):736–40.
20. Hickey RW, Bowman MJ, Smith GA. Utility of blood cultures in pediatric patients found to have pneumonia in the emergency department. Ann Emerg Med. 1996;27(6):721–5.
21. S.E. Katz, D.J. Williams. Pediatric community-acquired pneumonia in the United States: changing epidemiology, diagnostic and therapeutic challenges, and areas for future research. Infect Dis Clin North Am, 32 (2018), pp. 47-63.
22. Jadavji T, Law B, Lebel MH, Kennedy WA, Gold R, Wang EE. A practical guide for the diagnosis and treatment of pediatric pneumonia. CMAJ. 1997 Mar 01;156(5):S703-11.
23. Wubbel L, Muniz L, Ahmed A, et al. Etiology and treatment of community-acquired pneumonia in ambulatory children. Pediatr Infect Dis J 1998;18:98–104.
24. Harris JS, Kolokathis A, Campbell M, et al. Safety and efficacy of azithromycin in the treatment of communityacquired pneumonia in children. Pediatr Infect Dis J 1998; 17:865–71.
25. Block S, Hedrick J, Hammerschlag M, et al. Mycoplasma pneumoniae and Chlamydia pneumoniae in pediatric community-acquired pneumonia: comparative efficacy and safety of clarithromycin vs. erythromycin ethylsuccinate. Pediatr Infect Dis J 1995;14:471–7.
26. Manfredi R, Jannuzzi C, Mantero E, et al. Clinical comparative study of azithromycin versus erythromycin in the treatment of acute respiratory tract infections in children. J Chemother 1992;4:364–70.
27. Ficnar B, Huzjak N, Oreskovic K, et al. Azithromycin: 3-day versus 5-day course in the treatment of respiratory tract infections in children. Croatian Azithromycin Study Group. J Chemother 1997;9:38–43.
28. Schlaudecker EP, Frenck RW Jr. Adolescent pneumonia. Adolesc Med State Art Rev. 2010;21(2):202–219, vii–viii
29. Nascimento-Carvalho CM, Andrade DC, Vilas-Boas AL. An update on antimicrobial options for childhood community-acquired pneumonia: a critical appraisal of available evidence. Expert Opin Pharmacother. 2016; 17:53-78.
30. World Health Organization (WHO. Available from: Recommendations for management of common childhood conditions: evidence for technical update of pocket book recommendations: newborn conditions, dysentery, pneumonia, oxygen use and delivery, common causes of fever, severe acute malnutrition and supportive care. Geneva: WHO; 2012.
31. Michelow IC, Olsen K, Lozano J, et al. Epidemiology and clinical characteristics of community-acquired pneumonia in hospitalized children, Pediatrics, 2004, vol. 113 (pg. 701-7).
32. Fu LY, Ruthazer R, Wilson I, et al. Brief hospitalization and pulse oximetry for predicting amoxicillin treatment failure in children with severe pneumonia, Pediatrics, 2006, vol. 118 (pg. e1822-30).
33. John S. Bradley, MD Rady. Clinical Infectious Diseases 2011;53(7):e25–e76.