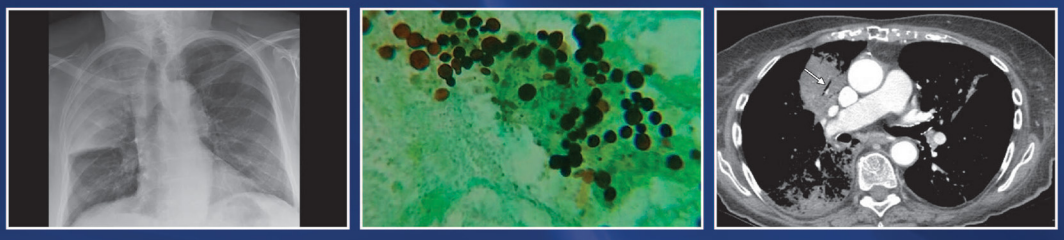
ISSN 2319-1260

2019 Volume 6 Number 1

World Clinics

PULMONARY & CRITICAL CARE MEDICINE

Pneumonia



Editor-in-Chief
Surinder K Jindal

Guest Editor
Ravindran Chetambath

JAYPEE

Contents

Editorial xi
Ravindran Chetambath

Acknowledgments xiii
Ravindran Chetambath

Abbreviations xv

Epidemiology and Risk Factors of Pneumonia **1**
Deepak Talwar, Rahul K Sharma

Etiological Diagnosis of Pneumonia **12**
Jyothi Edakalavan, Safreena M Nambipunnilath

Role of Imaging in Respiratory Infections **27**
Bhavin Dalal, Ishani Dalal, Korembeth P Ravikrishnan

Severity Assessment of Pneumonia **49**
Vivek Jayaschandran, Girish B Nair

Management of Pneumonia: An Overview **61**
Mohan Alladi, M Madhusudhan, J Harikrishna

Community-acquired Pneumonia **76**
Aditya Jindal, Surinder K Jindal

Hospital-acquired and Ventilator-associated Pneumonia **88**
Vijai Kumar Ratnavelu

Pneumonia in Immunocompromised Host **106**
George D'Souza

Atypical Pneumonias **121**
Sanjeev Nair

Viral Pneumonia **135**
Ravindran Chetambath, Safreena M Nambipunnilath

Fungal Pneumonias **146**
Raseela Karunakaran

Parasitic Pneumonias **168**
Ravindran Chetambath, Kiran V Narayan

Aspiration Pneumonias **180**
Devasahayam J Christopher, Shakti K Bal

Pneumonia in Children **198**
Sunny A Thomas, Ravindran Chetambath

World Clin Pulm Crit Care Med. 2019;6(1):1-10.

Epidemiology and Risk Factors of Pneumonia

[1,*]Deepak Talwar DM MD DNB, [2]Rahul K Sharma MD DM

[1]Department of Pulmonary, Critical Care and Sleep Medicine
Metro Group of Hospitals, New Delhi, India
[2]Department of Pulmonary, Critical Care and Sleep Medicine
Metro Centre for Respiratory Diseases, Noida, Uttar Pradesh, India

ABSTRACT

Respiratory tract infections are one of the most frequently reported infections requiring medical attention. Pneumonia is a common and potentially serious condition associated with high morbidity and mortality in all age groups. Pneumonia along with influenza was estimated to be the eighth most common cause of death in the United States and the 7th most common cause of death in Canada. The epidemiology of pneumonia is a dynamic process and has shown various changes in recent years. These changes are due to changes in the population at risk, discovery of new organisms that cause pneumonia, development of antimicrobial resistance, and seasonal variation in the occurrence of pneumonia.

INTRODUCTION

Respiratory tract infections are one of the most frequently reported infections requiring medical attention. Pneumonia is an infection of the pulmonary parenchyma. Community-acquired pneumonia (CAP) is defined as pneumonia not acquired in hospital or a long-term care facility. The CAP is a common and potentially serious condition associated with high morbidity and mortality in all age groups. Impact of CAP is far greater at extremes of age and in high-risk individuals.[1,2] Pneumonia remains the leading infectious cause of death among children under five years of age accounting for 15% of all-cause under 5 mortality in 2015. In a survey by the United Nations Children's Fund, CAP is estimated

*Corresponding author
Email: dtlung@gmail.com

© 2019 Jaypee Brothers Medical Publishers. All rights reserved.

JAYPEE BROTHERS

to be responsible for killing 2,500 children per day.[3] In elderly persons also (aged ≥65 years), the incidence of pneumonia is four times greater and associated with more hospitalization and death compared to adult population.[4-6] In this article, the authors review the epidemiology and important risk factors of CAP with emphasis on preventive strategies for the same.

EPIDEMIOLOGY

The overall rate of CAP in adults is approximately 5.16–6.11 cases per 1,000 persons per year; the numbers increase with increasing age.[7] However, the global incidence varies in different studies and different geographical regions based on population and community risk factors. Recent studies have shown that annual incidence of CAP in Europe is between 1.07 and 1.2 per 1,000 person-years and 1.54 and 1.7 per 1,000 people.[8] In United States, CAP occurs in approximately 4 million adults leading to 10 million physician visits, 1.1 million hospitalizations, and 50,000 deaths per year.[9-11] Due to the lack of epidemiological surveys, a clear population-based statistics on the condition is not available from developing countries like India.

The mortality resulting from CAP is high even in developed nations with best of health infrastructure indicating the high lethality of this disease. Pneumonia along with influenza was estimated to be the eighth most common cause of death in the United States and the seventh most common cause of death in Canada.[12,13] Globally, CAP is reported to account for approximately 3.5 million deaths per year and is considered to be highest cause of mortality among infectious diseases.[14] Global Burden of Disease Study in 2010, reported that lower respiratory tract infections, including pneumonia are the fourth most common cause of death globally, after ischemic heart disease, strokes, and chronic obstructive pulmonary disease, and they are the second most frequent reason for years of life lost. Approximately 90% of these deaths are due to pneumonia in people aged more than 65 years.[15] All-cause mortality in patients with CAP is reported as high as 28% within 1 year. As per the World Health Organization, estimated mortality per 100,000 population by pneumonia in India was 89.5 compared to 62 in the United Kingdom and 21.3 in the United States indicating a large mortality burden in lower socioeconomic countries.

The epidemiology of pneumonia is a dynamic process and has shown various changes in recent years. These changes are due to changes in the population at risk, discovery of new organisms that cause pneumonia, development of resistance to old microbial agents, seasonal variation in the occurrence of pneumonia, and increase in the number of immunocompromised patients like organ transplant recipients, number of patients with human immunodeficiency virus infection,

JAYPEE BROTHERS

patients receiving immunosuppressive drugs for the respiratory and nonrespiratory chronic disease, and association of multiple comorbidities.

RISK FACTORS

Several risk factors for CAP are recognized which affect the disease burden and prognosis. Knowledge about these risk factors is helpful when planning preventive measures to reduce its incidence and impact. Understanding a person with certain characteristics at high-risk of CAP can help to direct that intervention to reduce the risk of infection and impact of disease are targeted appropriately. These risk factors vary depending on the immune status of an individual and include both individual related nonmodifiable factors and lifestyle related modifiable factors along with predisposing host conditions (Table 1).

Age

The most significant and widely reported risk factor for pneumonia is age. With increase in life expectancy, adults aged over 65 years are rapidly expanding cohorts with growth rates almost double that of younger populations. In a report, 20% of the world's population will be more than 65 years of age by 2050. Thus, CAP burden will be even more significant in the coming years.[16] Estimated annual incidence of CAP is 25–44 cases per 1,000 persons in elderly population.[17]

Table 1: Risk Factors for the Development on Community-acquired Pneumonia

Immunocompetent at risk	Immunocompromised at risk

• Age
• Lifestyle
  ◦ Alcoholism
  ◦ Smoking
• Underlying diseases
  ◦ Chronic heart disease
  ◦ Chronic renal disease
  ◦ Chronic liver diseases
  ◦ Chronic respiratory diseases
  ◦ Metabolic disease
  ◦ CNS disease
• Prior invasive pneumococcal disease
• Previous pneumonia
• Other
  ◦ Aspiration
  ◦ Concomitant treatment
	• Immunosuppression
	  ◦ Autoimmune disease receiving steroid/ immunosuppressive/biological therapy
	  ◦ Cancer with immunosuppressive therapy
	  ◦ Waiting list for solid organ transplant
	  ◦ Other immunosuppression
	• Immunocompromised
	  ◦ Asplenia/splenic dysfunction
	  ◦ Primary immunodeficiency
	• Human immunodeficiency virus

CNS, central nervous system.

JAYPEE BROTHERS

Furthermore, the rates of hospitalization and mortality are also higher in this age group as a result of CAP.[4,18] In an observational cohort study of 623,718 patients aged 65 years or more, it was found that hospitalized rate was 18.3 per 1,000 cases in elderly patients with CAP when compared with four per 1,000 cases in younger populations.[4] The same study showed that hospitalization was even more in adults older than 90 years of age (five times more likely to be hospitalized than those aged 65–69 years). This data suggests that even within the elderly population, those with more advanced age are more susceptible to CAP. This would suggest a possible nonlinear effect, with older age as a risk factor for CAP. Mortality rates in the young patients with CAP are lower than in elderly populations.[17,19] A recent study by Kothe et al., demonstrated that age itself was associated with increased mortality in CAP.[19]

Gender and Race

The results of studies on gender as a risk factor for CAP are inconsistent. Some studies suggest that male gender was a risk factor for development of CAP,[20,21] with CAP incidence and hospitalization rates higher in men when compared to women. In a study done in the United Kingdom, the overall incidence per 1,000 person-years was 1.22 (1.18–1.26) in men and 0.93 (0.89–0.96) in women, whereas men and women aged more than 50 years reported rates of hospitalization for pneumonia per 1,000 person-years of 4.2 in men and 3.4 in women in Denmark.[22] However, these results were nonconsistent in few other studies.[23,24] There is no evidence that ethnicity plays a role as a risk factor for CAP.

Etiological Agent

The potential etiologic agents in CAP include bacteria, fungi, viruses, and protozoa. The true prevalence of the various etiologic agents in CAP is difficult and uncertain identifying etiological agent in clinical practice is difficult. Studies investigating the etiology of CAP by using a variety of microbiological techniques have been performed in different regions and in various patient populations and clinical settings. Most cases of CAP, however, are caused by relatively few pathogens. Pneumococcus has long been considered the major cause of CAP worldwide. More recently, with the introduction of rapid molecular diagnostics, viruses have been implicated to be an important causative agent of CAP along with gram-negative bacteria. Latest and most comprehensive microbiological study of etiologic agents of CAP [Centers for Disease Control and Prevention (CDC) Etiology of Pneumonia in the Community (EPIC) study] done in the United States 2,488 patients demonstrated that the most common etiological cause for CAP is viruses (22%), followed by bacteria (11%), and surprisingly pneumococcal

JAYPEE BROTHERS

pneumonia was seen in only 5% of the isolates. This changing microbiological pattern could be secondary to development of newer vaccines (e.g., pneumococcal vaccine) and potent antibiotics against bacterial agents, and availability of newer diagnostic tools capable of diagnosing viral pneumonias.[25]

Immunosuppression

An important factor responsible for changing etiology of CAP is the rapidly increasing number of immunocompromised patients including human immunodeficiency virus patients, post-transplant recipients, and patients on steroids and newer immunosuppressive therapy.

This subset of patients has a high risk of developing CAP not only with the conventional pathogens but also with wide spectrum of opportunistic pathogens; furthermore, the presentation may be severe or atypical in this population. List of these newer pathogens is ever expanding but most commonly recognized pathogens causing pneumonia include hantavirus, severe acute respiratory syndrome—coronavirus, human metapneumovirus, *Pneumocystis jirovecii, Staphylococcus aureus* isolates carrying the Panton–Valentine leukocidin (PVL) genes, and methicillin-resistant *S. aureus*.[26]

Smoking

Studies suggest that the risk of CAP increases between 50 and 400% in smokers.[27] Multivariate analyzes have shown that smoking has a direct effect on pneumonia onset that is independent of the underlying comorbidities. Quitting smoking is associated with decrease in incidence of CAP by 15–30%. The risk of CAP remains high in ex-smokers in the 2 years after quitting; thereafter, risk tends to fall with years of abstinence.[28,29] The impact of passive smoking is still not clearly understood; although, most studies have observed no significant effect in the overall population.

Alcohol

Other than so many deleterious effects of alcohol, a high level of alcohol consumption is also implicated in increasing chances of developing CAP. A recent study found an increased risk of CAP for men who were heavy drinker (>40 g/day of pure alcohol).[28] Further in the study, a dose response relationship was observed, with no effect observed in moderate drinkers (<40 g/day pure alcohol), even if they are found to consume alcohol daily. In this study, multivariate analysis revealed heavy alcohol consumption as an independent risk factor after eliminating the effects of smoking, chronic bronchitis, heart failure, or chronic liver disease. A

JAYPEE BROTHERS

similar study in United States cohort also found no association between low or moderate alcohol consumption and CAP.[29]

Environmental Factors

Enough evidence exists on direct effect of environmental and occupational pollution on lung diseases which include bronchitis,[30] bronchiolitis,[31] asthma,[32] chronic obstructive pulmonary disease,[33] and lung cancer.[34] Although all these chronic respiratory diseases in turn increases the risk of CAP, few studies have tried to look at the direct impact of air pollution on CAP. Their results have found soot, crystal silicon, cadmium, and cotton dust itself to be major risk factors for CAP.[33] A case control study concluded that metal fumes, especially iron, reversibly predisposes to CAP.[35] Another study demonstrated that construction and industrial field work (carpentry, painting, etc.) is associated with increased incidence of CAP, as compared to administrative work which was shown to be a protective factor.[36] Despite these few reported case studies, there is no strong literature evidence demonstrating any association between CAP and occupational contact with gases, vapors, gasoline, oil, hydrocarbons, organic, and inorganic fibers or ionizing and nonionizing radiation. An association has been reported between CAP and sudden workplace changes in temperature which was independent of underlying chronic bronchitis and respiratory infection.[34] It is likely that sudden changes in temperature that do not enable gradual adaptation may represent true risk factors for CAP. Further analysis stratified by age showed that people over 65 years of age are more susceptible to this sudden temperature changes.[37]

Sociodemographic

Overcrowding, defined as 10 or more people living in a house, has also been found as a risk factor for CAP. A low education level associated with specific dietary and hygiene habits and conditions that favor the development of CAP has also represented a higher risk for CAP when compared with higher education levels. However, the effect of education is lost once adjustments are made for comorbidity and for occupational status.[37] Married or in a partnership is also found to be a protective factor when compared to single, widowed, or separated. Teenage pregnancy and lack of essential support by health services add to the impact from this risk.

Hand hygiene are long being found as a crucial element in minimizing the spread of most organisms responsible for pneumonia. Simple hand washing with soap and water can reduce the incidence of acute respiratory infections by up to 50%.[23-25]

JAYPEE BROTHERS

Childhood Pneumonia

Risk factors for childhood pneumonias are quite varied from those in adults. Apart from the host factors, the incidence is majorly influenced by environmental and family factors. Poverty, poor immunization status, indoor air pollution, overcrowding, and maternal illiteracy appear as the major factors implicated in development of pediatric pneumonia.[38] Malnutrition/poor feeding practices is the single most important factor responsible for significantly increased morbidity and mortality due to pneumonia. More often in these children, manifestations of pneumonia remain occult leading to significantly more lethality.[39,40] Lack of education in parents has also found to be a significant risk factor for both the incidence of childhood pneumonia and as a determinant of the outcome in India.[41,42]

Risk factors pertaining to specific etiologies of CAP may differ from those for pneumonia as a whole and hence, knowledge of risk specific etiology also helps in narrowing down the etiological diagnosis (Table 2). Appropriate antibiotic therapy

Table 2: Risk Factors Pertaining to Specific Etiologies of Community-acquired Pneumonia

Epidemiological risk factors	Associated causative agents
Alcoholism	*Streptococcus pneumoniae*, oral anaerobes, and *Mycobacterium tuberculosis*
Chronic obstructive lung disease	*S. pneumoniae, Haemophilus influenzae, Moraxella catarrhalis, and Legionella* spp.
Exposure to bat a bird droppings, construction sites, caves	*Histoplasma capsulatum*
Exposure to birds	*Chlamydia psittaci*
Exposure to rabbits	*Francisella tularensis*
HIV infection	"Typical" bacterial pathogens, *M. tuberculosis, Pneumocystis jirovecii,* cytomegalovirus, *Cryptococcus* spp., *Histoplasma* spp., *Coccidioides* spp.
Travel to desert, Southwest United States	*Coccidioides* spp., hantavirus (Sin Nombre virus)
Farm exposure	*Coxiella burnetii* (animals), *Aspergillus* spp. (barns, hay)
Postinfluenza	*S. pneumoniae, S. aureus, Streptococcus pyogenes,* and *H. influenzae*

Continued

JAYPEE BROTHERS

Continued

Table 2: Risk Factors Pertaining to Specific Etiologies of Community-acquired Pneumonia

Epidemiological risk factors	Associated causative agents
Aspiration	Mixed aerobic, anaerobic
Marijuana smoking	*Aspergillus* spp.
Anatomic abnormality of lung parenchyma, e.g., bronchiectasis, cystic fibrosis	*Pseudomonas aeruginosa, Burkholderia cepacia,* and *S. aureus*
Injection drug use	*S. aureus,* anaerobes, *M. tuberculosis*, and *S. pneumoniae*
Obstruction of large airway	Anaerobes, *S. pneumoniae, H. influenzae,* and *S. aureus*
Incarceration	*M. tuberculosis*
Neutropenia	*Aspergillus* spp., zygomycetes
Asplenia	*S. pneumoniae, H. influenzae*

can be instituted if the exposure and possible clue to causative microorganisms is identified in the history. A possible correlation between various epidemiologic factors and bacteriological cause of CAP shown in table 2.[43] Patient at risk of aspiration like patients of gingivitis and an unprotected airway commonly seen in patients with alcohol or drug overdose or a seizure disorder, anaerobes play a significant role. Anaerobic pneumonias are often complicated by abscess formation and significant empyema or parapneumonic effusions. In hospitalized patient with CAP, atypical bacteria like *M. pneumonia* and *Legionella* spp. have also been detected in approximately 3–15% using nonserological techniques. *Staphylococcus aureus* and *Pseudomonas aeruginosa* are important etiological agents in patients with structural lung disease.[26]

CONCLUSION

Changes in the epidemiology of pathogens due to emergence of new pathogens and changing antimicrobial susceptibility of old ones, difficulty in making an etiologic diagnosis due to limited laboratory methods with low diagnostic yield, and complex pneumonia management guidelines make CAP a unique challenge for the physicians. The thorough knowledge of changing local and worldwide epidemiology, and risk factors, therefore, have implications on planning, further management strategies, and guideline protocols for CAP.

JAYPEE BROTHERS

Editor's Comment

Pneumonia is a common and potentially serious illness. It is associated with considerable morbidity and mortality, particularly in extremes of ages and those with significant comorbidities. An important reason for the increased mortality is the influence of pneumonia on chronic diseases, along with the increasing age of the population as well as virulence factors of the causative microorganisms. Respiratory viruses are considered the etiological agent in almost one-third of cases of community-acquired pneumonia. Influenza virus is usually self-limiting but severe complications can occur, particularly in high-risk individuals such as elderly patients with comorbidities or immunosuppressed patients. The choice of treatment is dependent on many factors. These include the setting in which pneumonia developed comorbid illnesses, severity of pneumonia, likely pathogen and likely sensitivity pattern of organisms. It is therefore important to have epidemiological data to guide us as to the likely pathogen that commonly cause pneumonia in our community or hospital setting. Epidemiological surveillance is all the more important to know the new and emerging pathogens causing pneumonia. Authors in this article clearly described the various epidemiological and risk factors in the causation of pneumonia.

Ravindran Chetambath

REFERENCES

1. Welte T, Torres A, Nathwani D. Clinical and economic burden of community-acquired pneumonia among adults in Europe. *Thorax*. 2012;67:71-9.
2. Blasi F, Mantero M, Santus P, et al. Understanding the burden of pneumococcal disease in adults. *Clin Microbiol Infect*. 2012;18:1-8.
3. UNICEF, one is too many: Ending child deaths from pneumonia and diarrhoea. New York; UNICEF, 2016.
4. Kaplan V, Angus DC, Griffin MF, et al. Hospitalized community-acquired pneumonia in the elderly: Age- and sex-related patterns of care and outcome in the United States. *Am J Respir Crit Care Med*. 2002;165(6): 766-72.
5. Fine MJ, Smith MA, Carson CA, et al. Prognosis and outcomes of patients with community acquire pneumonia. A meta-analysis. *JAMA*. 1996;275(2):134-41.
6. Chong CP, Street PR. Pneumonia in the elderly: A review of the epidemiology, pathogenesis microbiology, and clinical features. *South Med J*. 2008;101(11):1141-45.
7. Marrie TJ, Huang JQ. Epidemiology of community-acquired pneumonia in Edmonton, Alberta: An emergency department-based study. *Can Respir J*. 2005;12(3):139-42.
8. Torres A, Peetermans WE, Viegi G, et al. Risk factors for community-acquired pneumonia in adults in Europe: A literature review. *Thorax*. 2013;68:1057-65.
9. Minino AM, Murphy SL, Xu J, et al. Deaths: final data for 2008. *Natl Vital Stat Rep*. 2011;59:1-126.
10. Hall MJ, DeFrances CJ, Williams SN, et al. National Hospital Discharge Survey: 2007 summary. *Natl Health Stat Report*. 2010;(29):1-20, 24.
11. Grossman RF, Rotschafer JC, Tan JS. Antimicrobial treatment of lower respiratory tract infections in the hospital setting. *Am J Med*. 2005;118(7A):29S-38s.

JAYPEE BROTHERS

12. File TM Jr, Marrie TJ. Burden of community-acquired pneumonia in North American adults. *Postgrad Med*. 2010;122:130-41.
13. Kung HC, Hoyert DL, Xu J, et al. Deaths: Final data for 2005. *Natl Vital Stat Rep*. 2008;56:1-20.
14. Marrie TJ. Acute bronchitis and community acquired pneumonia. Fishman's Pulmonary diseases and disorders, 5th edition, 2015.
15. European commission. Health Statistics. Atlas on mortality in European Union. Luxembourg: Office for Official publications of the European Communities, 2008.
16. Donowitz GR, Cox HL. Bacterial community-acquired pneumonia in older patients. *Clin Geriatr Med*. 2007;23(3):515-34.
17. Janssens JP, Krause KH. Pneumonia in the very old. *Lancet Infect Dis*. 2004;4(2):112-24.
18. Fine MJ, Smith MA, Carson CA, et al. Prognosis and outcomes of patients with community acquired pneumonia: A meta-analysis. *JAMA*. 1996;275(2):134-41.
19. Kothe H, Bauer T, Marre R, et al. Outcome of community-acquired pneumonia: Influence of age, residence status and antimicrobial treatment. *Eur Respir J*. 2008;32(1):139-46.
20. Jackson ML, Neuzil KM, Thompson WW, et al. The burden of community-acquired pneumonia in seniors: Results of a population-based study. *Clin Infect Dis*. 2004;39:1642-50.
21. Vila-Corcoles A, Ochoa-Gondar O, Rodriguez-Blanco T, et al. Epidemiology of community-acquired pneumonia in older adults: A population-based study. *Respir Med*. 2009;103:309-16.
22. Rodriguez LA, Ruigomez A, Wallander MA, et al. Acid-suppressive drugs and community-acquired pneumonia. *Epidemiology*. 2009;20:800-6.
23. Koivula I, Sten M, Mäkelä PH. Risk factors for pneumonia in the elderly. Am J Med. 1994;96:313-20.
24. Gau JT, Acharya U, Khan S, et al. Pharmacotherapy and the risk for community-acquired pneumonia. *BMC Geriatr*. 2010;10:45.
25. Jain S, Self WH, Wunderink RG, et al. Community-acquired pneumonia requiring hospitalization among U.S. adults. *N Engl J Med*. 2015;373:415-27.
26. Mandell LA, Wunderink R. Pneumonia. Harrison's principles of internal medicine, 17th edition, 2008.
27. Almirall J, González CA, Balanzó X, et al. Proportion of community-acquired pneumonia cases attributable to tobacco smoking. *Chest*. 1999;116:375-79.
28. Almirall J, Bolíbar I, Balanzó X, et al. Risk factors for community-acquired pneumonia in adults: A population-based case-control study. *Eur Respir J*. 1999;13:349-55.
29. Baik I, Curhan GC, Rimm EB, et al. A prospective study of age and lifestyle factors in relation to community-acquired pneumonia in US men and women. *Arch Intern Med*. 2000;160:3082-88.
30. Fishwick D, Bradshaw LM, D'Souza W, et al. Chronic bronchitis, shortness of breath, and airway obstruction by occupation in New Zealand. *Am J Respir Crit Care Med*. 1997;156:1440-46.
31. Wright JL. Inhalational lung injury causing bronchiolitis. *Clin Chest Med*. 1993;14:635-44.
32. Chan-Yeung M, Malo JL. Aetiological agents in occupational asthma. *Eur Respir J*. 1994;7:346-71.
33. Hendrick DJ. Occupational and chronic obstructive pulmonary disease (COPD). *Thorax*. 1996;51:947-55.
34. Steenland K, Loomis D, Shy C, et al. Review of occupational lung carcinogens. *Am J Ind Med*. 1996;29:474-90.
35. Palmer KT, Poole J, Ayres JG, et al. Exposure to metal fume and infectious pneumonia. *Am J Epidemiol*. 2003;157:227-33.
36. Almirall J, Serra-Prat M, Bolíbar I, et al. Relación de las profesiones y las condiciones laborales con la neumonía adquirida en la comunidad. *Arch Bronconeumol*. 2015;51:627-31.
37. Almirall J, Bolíbar I, Serra-Prat M, et al. New evidence of risk factors for community-acquired pneumonia: A population-based study. *Eur Respir J*. 2008;31:1274-84.
38. Ebbert JO, Croghan IT, Schroeder DR, et al. Association between respiratory tract diseases and secondhand smoke exposure among never smoking flight attendants: A cross-sectional survey. *Environ Health*. 2007;6:28-36.
39. Chisti MJ, Tebruegge M, La Vincente S, et al. Pneumonia in severely malnourished children in developing countries - mortality risk, aetiology, and validity of WHO clinical signs: a systematic review. *Trop Med Int Health*. 2009;14:1173-89.

JAYPEE BROTHERS

40. Sehgal V, Sethi GR, Sachdev HP, et al. Predictors of mortality in subjects hospitalized with acute lower respiratory tract infections. *Indian Pediatr*. 1997;34:213-19.
41. Tiewsoh K, Lodha R, Pandey RM, et al. Factors determining the outcome of children hospitalized with severe pneumonia. *BMC Pediatr*. 2009;9:15
42. Shah N, Ramankutty V, Premila PG, et al. Risk factors for severe pneumonia in children in south Kerala: A hospital-based case control study. *J Trop Pediatr*. 1994;40:201-6.
43. Mandell LA, Wunderink RG, Anzueto A, et al. Infectious Diseases Society of America/American Thoracic Society consensus guidelines on the management of community-acquired pneumonia in adults. *Clin Infect Dis*. 2007;44(2):S27-72.

JAYPEE BROTHERS

Available at all medical bookstores
or buy online at www.jaypeebrothers.com



JAYPEE BROTHERS
Medical Publishers (P) Ltd.
www.jaypeebrothers.com

Join us on facebook.com/JaypeeMedicalPublishers

Shelving Recommendation
MEDICINE

