

Guideline for The Diagnosis and Management of Community Acquired Pneumonia: Adult

EXCLUSIONS

- ◆ Patients less than 16 years old
- ◆ Immunocompromised patients
- ◆ Hospital acquired pneumonia (onset after 4 days of hospitalization)
- ◆ Aspiration pneumonia
- ◆ Patients with cystic fibrosis or tuberculosis
- ◆ Pregnant women
- ◆ Residents of long term care facilities

DEFINITIONS

Pneumonia

- ◆ Acute infection of the pulmonary parenchyma that is associated with:
 - At least two of the following symptoms:
 - fever, rigors, new cough with or without sputum production or chronic cough with change in color of sputum, pleuritic chest pain, shortness of breath
- AND
- Auscultatory findings consistent with pneumonia (localized crackles, bronchial breath sounds)
- AND
- The presence of a new opacity on chest X-ray²

Community Acquired Pneumonia (CAP)

- ◆ Pneumonia that has been acquired in the community in a patient:
 - Who has not been hospitalized within 14 days prior to onset of symptoms²
- OR
- Hospitalized less than 4 days prior to onset of symptoms

ISSUES

- ◆ Microbiologic diagnosis of CAP has significant limitations and as such, treatment of CAP is usually empiric
- ◆ Chest radiography is underutilized in both the diagnosis and follow-up of CAP
- ◆ The overuse of antibiotics for ill-defined respiratory tract infections has led to the emergence of antibiotic resistant organisms
- ◆ Inappropriate choice and delay in administration of antibiotics for the treatment of CAP may lead to increased patient morbidity and mortality

GOALS

- ◆ To increase the accuracy of the clinical diagnosis of pneumonia
- ◆ To optimize the appropriate use of laboratory and diagnostic imaging services
- ◆ To optimize the use of antibiotics in the treatment of community acquired pneumonia in adults

PREVENTION

- ◆ Smoking cessation and avoidance of environmental tobacco smoke
- ◆ Limit the spread of viral infections (e.g., handwashing)
- ◆ Influenza vaccine is recommended annually for high risk patients (see Appendix 1)
- ◆ Pneumococcal vaccine is recommended for high risk patients (see Appendix 2)
- ◆ Rehabilitation and nutritional programs where appropriate

ETIOLOGY

See Tables 1 and 2

Table 1	
Usual pathogens	
<u>Outpatients</u>	
No comorbid factors	<i>S. pneumoniae</i> <i>M. pneumoniae</i> <i>C. pneumoniae</i>
Comorbid factors	<i>S. pneumoniae</i> <i>H. influenzae</i> <i>S. aureus</i> <i>M. catarrhalis</i> <i>Enterobacteriaceae</i> <i>C. pneumoniae</i>
<u>Hospitalized</u>	
Moderate/severe patients	<i>S. pneumoniae</i> <i>H. influenzae</i> <i>S. aureus</i> <i>Group A streptococci</i> <i>Enterobacteriaceae</i> <i>C. pneumoniae</i> <i>Legionella spp</i> (rare)

DIAGNOSIS

Clinical Assessment

- ◆ History:
 - Fever +/- chills
 - New onset of cough which may or may not be productive
 - Pleuritic chest pain
 - Constitutional symptoms such as fatigue, headache, nausea and vomiting, abdominal pain, myalgias
- ◆ Identification of Risk Factors:
 - Smoking
 - Comorbid conditions: asthma, smoking, lung cancer, chronic obstructive pulmonary disease (COPD), diabetes, alcoholism, chronic renal or liver failure, congestive heart failure (CHF), chronic corticosteroid use, malnutrition or acute weight loss (>5%), HIV
 - Recent (3 months) antibiotic history*
 - Hospitalization in past 3 months

**Note: See background*
- ◆ Physical examination:
 - Temperature > 37.8°C

Note: Basal temperature in the frail elderly is often lower

 - Tachypnea (respiratory rate ≥ 25 / minute)

Note: Respiratory rate must be counted for a full minute

 - Signs of consolidation: diminished chest expansion, increased tactile vocal fremitus, dullness on percussion, diminished air entry, bronchial breath sounds, whispering pectoriloquy, localized crackles, pleural rub

Table 2¹

Clues to the epidemiology and etiology of pneumonia based on the medical history

Feature	Possible Etiologic Agent or Associated Condition
<u>Environmental</u>	
<ul style="list-style-type: none"> exposure to contaminated air conditioning, cooling towers; hot tub; recent travel and stay in a hotel; grocery store mist machine; visit to or recent stay in a hospital with drinking water contaminated by <i>L. pneumophila</i> 	<i>Legionella pneumophila</i>
<ul style="list-style-type: none"> exposure to infected parturient cats, cattle, sheep, goats 	<i>Coxiella burnetii</i>
<ul style="list-style-type: none"> pneumonia develops after windstorm in an area of endemicity 	<i>Coccidioides immitis</i>
<ul style="list-style-type: none"> homeless, incarcerated, or intravenous drug user 	<i>S. pneumoniae</i> , <i>Mycobacterium tuberculosis</i> Methicillin resistant <i>S. aureus</i>
<ul style="list-style-type: none"> outbreak of pneumonia in military training camp 	<i>S. pneumoniae</i> , <i>C. pneumoniae</i> , adenovirus, <i>M. pneumoniae</i>
<ul style="list-style-type: none"> outbreak of pneumonia in a nursing home 	<i>C. pneumoniae</i> , <i>S. pneumoniae</i> , respiratory syncytial virus, influenza A virus
<ul style="list-style-type: none"> exposure to contaminated bat caves; excavation in areas of endemicity 	<i>Histoplasma capsulatum</i>
<ul style="list-style-type: none"> exposure to turkeys, chickens, ducks, or psittacine birds 	Avian influenza, <i>Chlamydia psittaci</i>
<ul style="list-style-type: none"> exposure to mice or mice droppings 	Hantavirus
<ul style="list-style-type: none"> exposure to rabbits 	<i>Francisella tularensis</i>
<ul style="list-style-type: none"> exposure to suspicious white powder (in the setting of bio-terrorist activity) 	<i>Bacillus anthracis</i>
<u>Travel History</u>	
<ul style="list-style-type: none"> travel to Thailand or other countries in Southeast Asia 	Avian influenza, <i>Burkholderia pseudomallei</i> (melioidosis) <i>M. tuberculosis</i>
<u>Asia</u>	
<ul style="list-style-type: none"> immigration from countries with high endemic prevalence of tuberculosis 	SARS
<u>Occupational History</u>	
<ul style="list-style-type: none"> health care work 	<i>M. tuberculosis</i> , acute HIV seroconversion with pneumonia
<ul style="list-style-type: none"> tick bite (<i>Dermacentor variabilis</i> or <i>Ixodes dommini</i> [scapularis]) 	Rocky Mountain spotted fever (rarely complicated by pneumonia), <i>Ehrlichia species</i>
<u>Host Factor</u>	
<ul style="list-style-type: none"> diabetic ketoacidosis 	<i>S. pneumoniae</i> , <i>Staphylococcus aureus</i>
<ul style="list-style-type: none"> alcoholism 	<i>S. pneumoniae</i> , <i>Klebsiella pneumoniae</i> , <i>S. aureus</i> , anaerobes
<ul style="list-style-type: none"> chronic obstructive lung disease 	<i>S. pneumoniae</i> , <i>Haemophilus influenzae</i> , <i>Moraxella catarrhalis</i>
<ul style="list-style-type: none"> solid organ transplantation (pneumonia occurring > 3 months after transplantation) 	<i>S. pneumoniae</i> , <i>H. influenzae</i> , <i>Legionella</i> species, <i>Pneumocystis jiroveci</i> (previously <i>carinii</i>). (rarely CMV), <i>Strongyloides stercoralis</i>
<ul style="list-style-type: none"> sickle cell disease 	<i>S. pneumoniae</i>
<ul style="list-style-type: none"> HIV infection and CD4 cell count < 200/μL 	<i>P. jiroveci</i> (previously <i>carinii</i>), <i>S. pneumoniae</i> , <i>H. influenzae</i> , <i>Cryptococcus neoformans</i> , <i>M. tuberculosis</i> , <i>Rhodococcus equi</i>
<ul style="list-style-type: none"> B cell defects (e.g., multiple myeloma, Hodgkin's disease) 	Aerobic Gram-negative bacilli (e.g., <i>Escherichia coli</i> or <i>K. pneumoniae</i>)
<ul style="list-style-type: none"> bronchiectasis 	<i>Pseudomonas aeruginosa</i>

1. Adapted from: Mandell L, Marrie T, Grossman R, et al. Canadian guidelines for the initial management of community acquired pneumonia: an evidence based update by the Canadian Infectious Diseases Society and the Canadian Thoracic Society. *Clin Infect Dis*, 2000; 31: 383-421 and Mandell L, Bartlett J, Dowell S, et al. Update of practice guidelines for the management of community acquired pneumonia in immunocompetent adults. *J. Clin Infect Dis*, 2003; 37: 1405-1433.²

Investigations

All Patients

- Chest X-ray, PA and lateral
- CBC with differential
- Sputum gram stain and culture only if productive cough
- Blood cultures* for those who present to ER with history of chills/rigors

Additional Tests for Hospitalized Patients

- Blood cultures*
- Chemistry – glucose, electrolytes, creatinine, ALT
- Pulse oximetry
- Arterial blood gas if patient:
 - O₂ sat < 90%
 - has COPD
 - receiving chronic oxygen (do on baseline O₂)
- Thoracentesis should be considered in patients with significant pleural effusion
- Serology is **not** routinely recommended

*Note: 1 set blood culture = 3 vials: 1 vial aerobic / 1 vial anaerobic from one site + 1 vial aerobic from a second site AT SAME TIME

MANAGEMENT

Up to 80% of patients with CAP are treated as outpatients.¹

General

- ◆ Ensure adequate hydration
- ◆ Adequate analgesics/antipyretics for pain and fever
- ◆ Cough suppressants are not routinely recommended
- ◆ For patients who may require admission to hospital, calculation of Pneumonia Severity of Illness (PSI) score is recommended to guide determination of site of care (See Appendix 3 and 4).

Note: The pneumonia severity of illness score is a guide and should never replace a physician's judgement as to the admission decision.

- ◆ Significant pleural effusion (> 10 mm on lateral decubitus) should be drained

- ◆ Empyema should be drained

Oxygen

- ◆ Oxygen therapy is indicated for hypoxemia

Antibiotic Therapy

Due to morbidity and mortality of bacterial pneumonia, and limitations of microbiologic diagnosis, empiric therapy is recommended for all patients with physical findings of pneumonia and new infiltrate on chest X-ray.

- ◆ See Tables 3 and 4 for antibiotic therapy recommendations

Antibiotics NOT routinely recommended in adult CAP

- Cephalexin - no activity against Pen I/R *Streptococcus pneumoniae*, *Haemophilus spp.*, *Mycoplasma pneumoniae*, or *Chlamydophila pneumoniae*
- Ciprofloxacin - poor activity against *Streptococcus pneumoniae* and atypical organisms
- Trimethoprim Sulfamethoxazole (TMP/SMX) - increased *Streptococcus pneumoniae* resistance. No coverage of *Mycoplasma pneumoniae* or *Chlamydophila pneumoniae*

FOLLOW-UP

- ◆ Follow-up for outpatients should occur at 48 to 72 hours
- ◆ Follow-up chest X-ray recommended at 6 weeks to ensure resolution and exclude underlying diseases such as empyema, lung abscess, and malignancy if:
 - Extensive/necrotizing pneumonia
 - Smoker
 - Alcoholism
 - COPD
 - > 5% weight loss in past month
 - > 50 years old

Table 3: Antibiotic Agents in Outpatient Treatment of CAP in Adult Patients

Recommended Agent	Dose
No Comorbid Factors¹	
<u>Doxycycline</u>	200mg PO first dose then 100mg PO bid 7 to 10 days
<u>OR</u>	
<u>Azithromycin</u>	500mg PO 1st day then 250mg PO daily 4 days
<u>OR</u>	
<u>Clarithromycin</u>	250 to 500mg PO bid 7 to 10 days OR XL 1 g PO daily for 7 to 10 days
<u>OR</u>	
<u>Erythromycin</u>	500mg PO qid 7 to 10 days

Recent antibiotic therapy (past 3 months)² Choose a different class of agent than previously used and ADD

Amoxicillin High dose 1g PO tid 7 to 10 days

Comorbid Factors¹	
<u>Doxycycline</u>	200mg PO first dose then 100mg PO bid 7 to 10 days
<u>OR</u>	
<u>Azithromycin</u>	500mg PO 1st day then 250mg PO daily 4 days
<u>OR</u>	
<u>Clarithromycin</u>	250 to 500mg PO bid 7 to 10 days OR XL 1g PO daily for 7 to 10 days

Recent antibiotic therapy (past 3 months)² Choose a different class of agent than previously used and ADD

Amoxicillin High dose 1g PO tid 7 to 10 days

OR
Amoxicillin-clavulanate³ 875mg PO bid 7 to 10 days

Failure of 1st Line Agents [Hemodynamic compromise (see In-Patient recommendations below and consider admission to hospital) OR clinical deterioration after 72 hours of antibiotic therapy OR no improvement after completion of antibiotic therapy]. **Choose a regimen not previously used as first line therapy, or within previous 3 months if possible.**

<u>[Amoxicillin-clavulanate³</u>	875mg PO bid 7 to 10 days
<u>OR</u>	
<u>Cefuroxime axetil</u>	500mg PO bid 7 to 10 days
<u>PLUS</u>	
<u>[Azithromycin</u>	500mg PO 1st day then 250mg PO daily 4 days
<u>OR</u>	
<u>Clarithromycin</u>	250 to 500mg PO bid 7 to 10 days OR XL 1 g PO daily for 7 to 10 days
<u>OR</u>	
<u>Erythromycin]</u>	500mg PO qid 7 to 10 days
Alternative	
<u>Levofloxacin</u>	500mg PO daily 7 to 10 days OR 750mg PO daily 5 days
<u>OR</u>	
<u>Moxifloxacin</u>	400mg PO daily 7 to 10 days

Notes

1. Comorbid/risk factors include: asthma, lung cancer, COPD, diabetes, alcoholism, chronic renal failure or liver failure, CHF, chronic corticosteroid use, malnutrition or acute weight loss (>5%), hospitalization in past 3 months, HIV, smoking
2. Antibiotic therapy within the previous 3 months is a risk factor for resistant *S. pneumoniae*. Amoxicillin provides the best coverage of all oral β -lactams against *S. pneumoniae*, even penicillin-intermediate strains.
3. Amoxicillin-clavulanate preferred over amoxicillin if Gram negative (alcoholism, recent hospitalization) or Staph (diabetes, recent influenza infection) species are a concern.

Table 4: Antibiotic Treatment for Adults Admitted to Hospital With CAP

Recommended Agent	Dose
[Cefuroxime OR Cefotaxime OR Ceftriaxone] PLUS [Doxycycline OR Macrolide ⁴]	750mg IV q 8h 10 days 1g IV q8h 10 days 1g IV daily 10 days 200mg PO 1st dose thn 100mg PO bid 10 days
<u>Alternative</u> Respiratory Quinolone ⁵	10 days
<u>Severe</u> [Cefotaxime OR Ceftriaxone] PLUS [Macrolide ⁴ OR Respiratory Quinolone ⁵]	1g IV q 8h 10 to 14 days 1g IV daily 10 to 14 days
<u>Cephalosporin Allergy</u> Respiratory Quinolone ⁶ PLUS Another antibiotic (clindamycin, macrolide ⁴ , vancomycin)	10 to 14 days 10 to 14 days (exception is azithromycin for 5 days)

Notes

4. Macrolide: Azithromycin (500mg IV/PO 1st day then 250 mg PO daily 4 days), Clarithromycin (500mg PO bid 10 days), or Erythromycin (0.5 - 1g IV q6h/500mg PO qid 10 days)
5. Respiratory Quinolone: Levofloxacin (500 mg IV/PO daily 10 days OR 750 mg IV/PO daily 5 days), or Moxifloxacin (400 mg IV/PO daily 10 days)
6. Respiratory Quinolone: Levofloxacin (500 mg IV/PO daily 10-14 days), or Moxifloxacin (400 mg IV/PO 10-14 days).

FAILURE OF THERAPY

- ◆ Definition:
 - Hemodynamic compromise
 - OR
 - Clinical deterioration after 72 hours of antibiotic therapy
 - OR
 - No improvement after completion of antibiotic therapy.
-
- ◆ Consider:
 - Host-related factors:
 - Noninfectious pulmonary pathology
 - Immunosuppressed
 - Pathogen-related factors:
 - Antibiotic resistance
 - Non-bacterial etiology
 - viruses
 - Mycobacterium spp
 - fungi
 - Drug related factors:
 - Compliance
 - Malabsorption
 - Drug-drug interactions
 - Drug fever

BACKGROUND

Incidence

Pneumonia is the leading cause of death from infection and the sixth leading cause of death overall.² In the United States, the annual incidence is 12 cases per 1,000 adults.¹ Incidence of CAP is increased in the winter months.² Up to 80% of cases of CAP are treated in the outpatient setting.⁴ Mortality is less than 1% for outpatients, but rises to an average of 14% for hospitalized patients with CAP.² Fifty percent of pneumonia cases and 90% of mortality from pneumonia are found in patients over the age of 65.

Etiology (see Tables 1 and 2)

In almost one-half of cases of pneumonia an etiologic agent is not found.

Streptococcus pneumoniae (*S. pneumoniae*) is the most common bacterial pathogen causing CAP and may account for up to 50% of CAP.¹

Note: risk factors for antibiotic resistant *S. pneumoniae* include²⁷:

- beta-lactam/macrolide/quinolone use within past 3 months
- alcoholism
- age > 65 years
- immunosuppression
- exposure to child(ren) attending childcare facility
- resident of a long term care facility.^{5,6}

Previous β -lactam and macrolide therapy are risk factors for penicillin resistant *S. pneumoniae*. Penicillin resistant *S. pneumoniae* often exhibits multiple resistance especially to oral cephalosporins, macrolides and TMP/SMX. Prior quinolone therapy, especially with ciprofloxacin, is a risk factor for quinolone resistant *S. pneumoniae*.

Other pathogens causing CAP include: *Mycoplasma pneumoniae*, *Chlamydia pneumoniae*, *Haemophilus influenzae* (mostly nontypeable), *Moraxella catarrhalis*, *Group A Streptococcus*, *Staphylococcus aureus*. *Klebsiella pneumoniae* and other gram-negative bacilli may cause pneumonia in patients with comorbid factors. *M. pneumoniae* accounts for 20% of CAP in outpatients and is more prevalent in younger age groups. *S. aureus*, including MRSA may cause pneumonia after influenza infection. *C. pneumoniae* accounts for 10% of pneumonias in outpatients and may be a co-pathogen in the elderly and may vary in incidence according to geographic location.

Elderly patients are more likely to be colonized with Gram-negative organisms (especially if decreased functional status, institutionalized and multiple co-morbid illnesses).

Viruses (e.g., influenza virus A and B, parainfluenza, adenovirus) account for at least 2 to 15% of adult cases. Influenza should be considered during the appropriate season. Respiratory syncytial virus, a significant pathogen in young children, is also emerging as an important respiratory pathogen in adults.¹

Tuberculosis (TB) should be considered (especially in the elderly). There is a 10 to 30 times increased incidence of TB in long term care residents than in the elderly living at home and long term care residents account for 20% of cases in older people.⁷

Although anaerobes are not common pathogens in CAP, they may play a role in polymicrobial aspiration syndromes in the elderly or debilitated (alcoholism, intravenous drug use, neurologically impaired, poor oral hygiene). In this setting, correlation with Gram stain (presence of multiple bacterial morphotypes phagocytosed in WBCs) is important.^{8,9}

PATHOGENESIS

In up to 50% of cases, a viral infection precedes the development of pneumonia and undoubtedly plays a role in the pathogenesis of pneumonia.^{1,4} Viruses may inhibit important host defenses, including ciliary activity, neutrophil function, and other lung defense mechanisms.⁴ Cigarette smoke compromises mucociliary function and macrophage activity. Alcohol impairs the cough reflex, increases oropharyngeal colonization with gram-negative bacilli, and may inhibit immune mechanisms.⁴ Elderly patients are at increased risk of developing pneumonia due to multiple factors: increased number and severity of comorbidities, decreased mucociliary clearance, diminished cough reflex, increased aspiration, increased colonization with gram-negative organisms, and depressed immune system.⁴

DIAGNOSIS

Diagnosis of pneumonia is based on a patient's history, comorbidities, physical findings, and chest X-ray. Symptoms of CAP most commonly include fever, chills, dyspnea, pleuritic chest pain, and cough. With increasing age, symptoms of infection may not be as apparent and physical signs may be diminished. Fever may be less commonly observed but delirium and confusion may be more common in this population.

Clinical Assessment

Normal respiratory rate in the elderly is 16 to 25 breaths per minute.¹⁰ A respiratory rate of > 25 breaths per minute has a sensitivity of 90% and a specificity of 95% for the diagnosis of pneumonia.

A single temperature of 38.3°C has a sensitivity of only 40% for predicting infection. Lowering the threshold to 37.8°C increases the sensitivity to 70%. Basal body temperature in the frail elderly is lower than 37.°C however.^{1,5} An increase of 1.1°C over baseline on

at least two occasions may be a better temperature criteria in the elderly.¹¹

Delirium or acute confusion is found in 44.5% of elderly patients with pneumonia.¹²

Investigations

Chest X-ray is the gold standard for diagnosis of CAP and should be done in all patients with findings consistent with pneumonia.

Some radiographic patterns suggest certain infections and may help to support a diagnosis of pneumonia versus an alternate cause. Comorbid lung or cardiovascular disease can be identified and the severity of the illness may be judged by the extent of lung involvement on chest X-ray.

Complete blood count with differential is recommended for all patients. In the elderly, the total WBC count and number of bands are one of the best indicators of bacterial infection.¹³ In addition, the following laboratory values should be determined for patients who are hospitalized: glucose, electrolytes, creatinine, ALT.

Collection of sputum for Gram stain and culture is recommended if the patient has a productive cough. Although sputum cultures may be of limited value, special attention should be paid to the Gram stain, especially if intra-cellular organisms are seen. This may provide some information on the etiological agent.

Patients being managed as outpatients should have a blood culture if they give a history of chills/rigors associated with fever. Blood cultures should be done in all hospitalized patients, preferably before antibiotic treatment. Obtaining a blood culture within 24 hours of presentation has been associated with improved 30 day survival in patients with community acquired pneumonia.¹⁴

Oxygen saturation should be assessed by pulse oximetry. If O₂ sat < 90% or patient has COPD, arterial blood gas should be drawn on room air, or on baseline O₂ if patient is receiving chronic oxygen. Hypoxemia is one of the important indicators of acute severity and short term mortality in CAP.¹⁵

Thoracentesis is indicated in patients with significant pleural effusion defined as fluid collection >10mm in thickness on the lateral decubitus view.

Serology is **not** routinely recommended. Legionella urinary antigen testing is not recommended routinely as Legionella is rare locally, but should be considered in patients with severe CAP with relevant environmental exposure (see Table 2) or travel history to endemic areas.

Routine use of invasive testing (bronchoscopy, bronchoalveolar lavage, etc.) is **not** recommended.

The presence of recurrent pneumonia should lead to investigation for immune system disorders or structural abnormalities.

MANAGEMENT

General

Adequate hydration of patients with CAP is essential. Many patients with pneumonia are dehydrated due to increased insensible water loss.

Nutritional status, especially in the elderly, is a very important factor. Weight loss of >5 to 10% can result in increased mortality.⁵

Antibiotic Therapy

The choice of empiric therapy should be based on severity of illness, patient age, comorbidities, treatment setting (outpatient or hospital), local susceptibility patterns where available, and patient's recent (3 months) antibiotic history.

Empiric therapy of outpatient CAP should always cover *S. pneumoniae*, and intracellular pathogens such as *M. pneumoniae* and *C. pneumoniae*. The antibiotic of choice for outpatient therapy of CAP is doxycycline as there is less *S. pneumoniae* resistance compared to the macrolides and it is one-tenth the cost of newer macrolides.²⁶ Alternative agents are the macrolides (erythromycin, azithromycin, clarithromycin).

Macrolide resistance of *S. pneumoniae* in Canada is reported to be as high as 14%²⁸ and coverage of *Haemophilus spp* is not optimal. Azithromycin has no appreciable serum concentrations and should be avoided in patients who present with rigors/chills as this may be an indicator of bacteremia.

Antibiotic therapy within the previous 3 months is a risk factor for resistant *S. pneumoniae*. Amoxicillin provides the best coverage of all oral beta-lactams against *S. pneumoniae*, even penicillin-intermediate strains.

Therefore, if patients have received an antibiotic within the previous 3 months, high dose amoxicillin should be added to the empiric regimen of either doxycycline or a macrolide. If the patient is also at risk for infection with Gram negative organisms (alcoholism, recent hospitalization) and/or *S. aureus* (diabetes, recent influenza), amoxicillin-clavulanate should be added rather than amoxicillin alone.

Levofloxacin and moxifloxacin provide excellent coverage of the pathogens involved, but because of their broad spectrum and potential for increasing resistance in *S. pneumoniae*, they should be reserved for patients who have failed first line therapy.

Ciprofloxacin does not have adequate coverage of *S. pneumoniae* and should not be used in the management of CAP. Additionally, ciprofloxacin (a hydrophilic molecule in comparison to the hydrophobic nature of most other quinolones) has been shown to activate efflux pumps which may be the initial step in the development of quinolone resistance.¹⁶

S. pneumoniae resistance in the Capital Health Region (excluding UAH)

Penicillin	12%
Intermediate level	9%
High Level	3%
Amoxicillin	2%
Cefuroxime	7%
Cefotaxime/ceftriaxone	2%
Macrolide	16%
Clindamycin	5%
Tetracycline	8%
TMP-SMX	18%
Levofloxacin	3%
Vancomycin	0%

* Based on 514 clinically significant isolates in 2004 from DKML.

In severe pneumonia, combination therapy with a beta-lactam plus a macrolide is recommended.^{17-19,26}

Hospitalization

Fine et al devised and validated a scoring system for predicting mortality in CAP that is also useful for identifying patients who should be admitted to hospital. For patients who may require admission to hospital, calculation of this Pneumonia Severity of Illness (PSI) score is recommended (Appendix 3 & 4). The pneumonia severity of illness score is a guide and should

never replace a physician's judgement as to the admission decision.

All patients who require admission to hospital for treatment of CAP should receive antibiotics within 4 to 8 hours of arrival to hospital. If antibiotic therapy is delayed for more than 4-8 hours, the mortality rate is much higher than if antibiotics are given within 4-8 hours.²⁰

Recovery is often prolonged in the elderly and may take up to several months. Hospitalization of this population may often hasten functional decline.

Follow-up

Post-treatment chest x-ray is recommended as 2% of patients with pneumonia have underlying cancer and 1% will only be visible on follow-up x-ray.

Poor outcome risk factors:

- Respiratory rate \geq 30 per minute
- Systolic blood pressure \leq 90 mmHg, diastolic blood pressure \leq 60 mmHg
- Acute renal dysfunction
- Malnourishment or $>$ 5% weight loss in past month (nutritional consult recommended)
- Functional impairment (occupational therapy and/or physiotherapy consult recommended)
- Age and comorbid factors are also contributors to outcome^{15,21}

PREVENTION

- ◆ Pneumococcal vaccine is recommended for high risk patients (see Appendix 2)
 - ◆ Rehabilitation (occupational therapy and/or physiotherapy) and nutritional programs where appropriate.
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TOWARD OPTIMIZED PRACTICE (TOP) PROGRAM

The successor to the Alberta Clinical Practice Guideline (CPG) program, TOP is an initiative directed jointly by the Alberta Medical Association, Alberta Health and Wellness, the College of Physicians and Surgeons, and Alberta's Health Regions. The TOP Program promotes appropriate, effective and quality medical care in Alberta by supporting the use of evidence-based medicine.

TO PROVIDE FEEDBACK

The Alberta CPG Working Group for Antibiotics is a multi-disciplinary team composed of family physicians, infectious diseases specialists, pediatricians, hospital and community pharmacists, a microbiologist, epidemiologist and consumers. The team encourages your feedback. If you have difficulty applying this guideline, if you find the recommendations problematic, or if you need more information on this guideline, please contact:

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APPENDIX 1

INFLUENZA VACCINE²³

Vaccine should be given annually to:

People at high risk of Influenza-related complications:

- adults and children with chronic cardiac or pulmonary disorders that are severe enough to require regular medical follow-up or hospital care (including bronchopulmonary dysplasia, cystic fibrosis, and asthma)
- people of any age who are residents of nursing homes and other chronic care facilities
- people ≥ 65 years of age
- adults and children with chronic conditions, such as diabetes mellitus and other metabolic diseases, cancer, immunodeficiency, immunosuppression (due to underlying disease and/or therapy), renal disease, anemia and hemoglobinopathy
- adults and children who have any condition that can compromise respiratory function or the handling of respiratory secretions or that can increase the risk of aspiration
- healthy children 6-23 months of age
- children and adolescents (6 months - 18 yrs) with conditions treated with long term acetylsalicylic acid
- people at high risk of influenza complications (as outlined above) embarking on travel to destinations where influenza is likely to be circulating

People capable of transmitting influenza to those at high risk:

- health care and other service providers in facilities and community settings who, through their activities, are potentially capable of transmitting influenza to those at high risk for influenza complications
- those who provide services within closed or relatively closed settings to persons at high risk (e.g. crew on ships)
- household contacts (adults and children) of people at high risk of influenza complications, including household contacts of children < 6 months of age who are at high risk of complications from influenza but for whom there is no currently licensed vaccine, household contacts of children 6-23 months of age (whether or not they have been immunized), pregnant women if they are expected to deliver during influenza season (as they will become household contacts of their newborn)
- those providing regular child care to children 0-23 months of age, whether in or out of the home

Others:

- people who provide essential community services
- people in direct contact with poultry infected with avian influenza during culling operations
- healthy persons 2-64 years of age should be encouraged to receive the vaccine, even if they are not in one of the aforementioned priority groups

Protection begins 2 weeks post vaccination and lasts < 1 year (may be as short as 4 months in the elderly).

APPENDIX 2

POLYSACCHARIDE PNEUMOCOCCAL VACCINE^{24,25}

Strongly Recommended - high risk*:

- asplenia (traumatic/surgical/congenital)
- splenic dysfunction
- sickle cell disease
- transplant (bone marrow, solid organ)

* NB:

- Where possible give vaccine 10-14 days prior to splenectomy or at beginning of chemotherapy for Hodgkin's disease.
- If in high risk category, even if have received conjugate pneumococcal vaccine, polysaccharide vaccine should be given at/or after 2 years of age.
- Vaccine failures may occur in this group - advise counseling (re: fulminant pneumococcal sepsis and need to seek early medical advice with fever).

Recommended:

- all persons ≥ 65 years old
- all residents of long term care facilities
- patients with chronic cardiovascular/pulmonary disease; chronic liver disease, including cirrhosis; alcoholism; chronic renal disease; nephritic syndrome; diabetes mellitus; conditions associated with immunosuppression, including HIV infection; chronic cerebrospinal fluid (CSF) leak; cochlear implant

NB:

- Vaccine may be administered simultaneously with influenza vaccine (separate injection site)

Not Recommended:

- children < 2 years of age
- asthma (as the single underlying condition)
- otitis media (as the single underlying condition)

Re-immunization:

- Consider for individuals with:
 - chronic liver disease/cirrhosis
 - chronic renal disease
 - nephrotic syndrome
 - conditions associated with immunosuppression, including HIV infection
 - asplenia, splenic dysfunction
 - sickle cell disease

Single revaccination should be given at:

- 3 years if initial dose given at ≤ 10 years of age
- 5 years if initial dose given at > 10 years of age

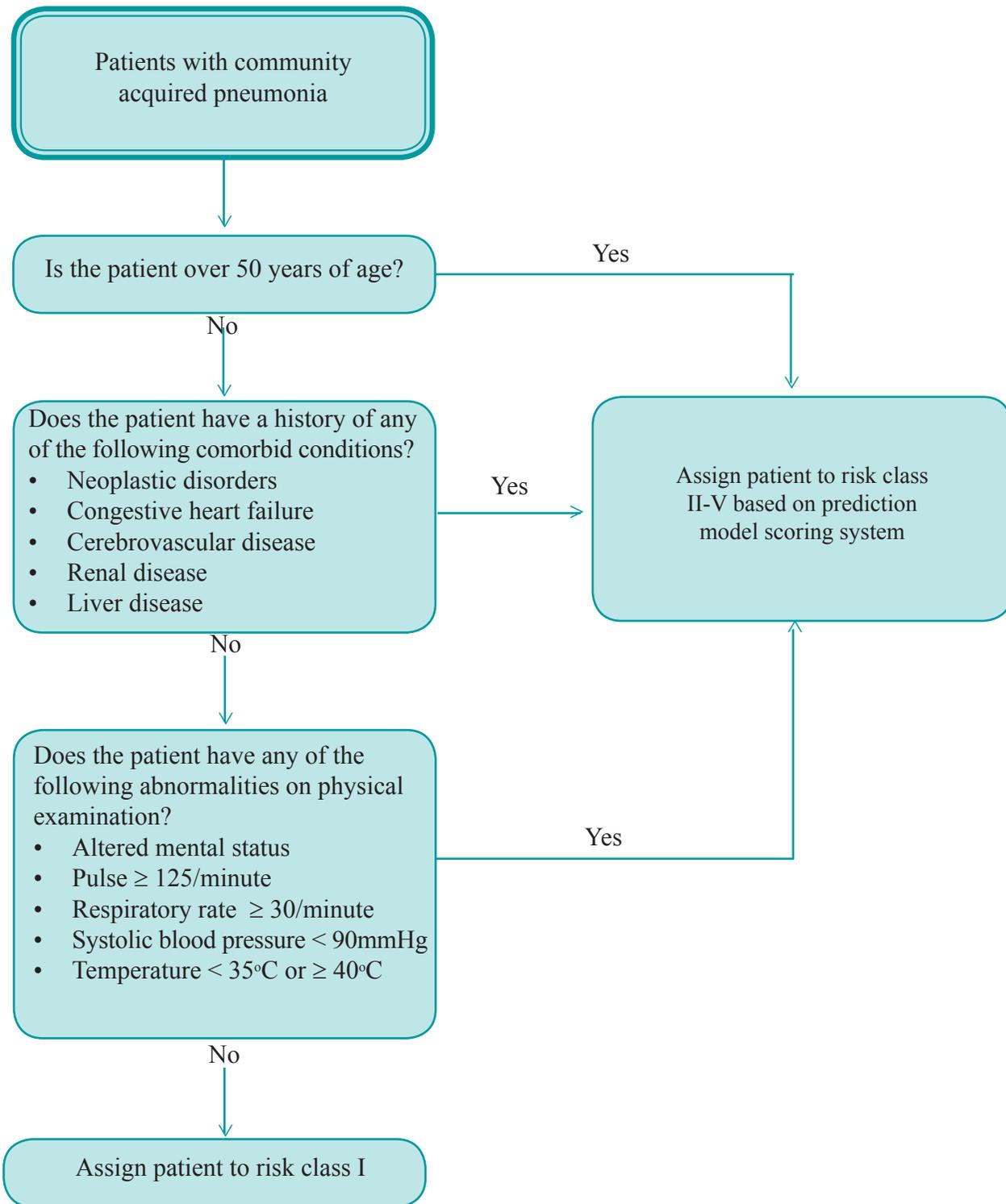
NB:

Individuals > 65 years of age who do not have one of the above six risk factors do NOT need revaccination.

APPENDIX 3

PREDICTION MODEL FOR IDENTIFICATION OF PATIENT RISK FOR PERSONS WITH COMMUNITY ACQUIRED PNEUMONIA

See appendix 4 for Pneumonia Specific Severity of Illness (PSI) scoring system



Reprinted from: Fine MJ, Auble TE, Yearly DM, et. al. A Prediction rule to identify low-risk patients with community acquired pneumonia. *New England Journal of Medicine*, 1997; 336: 243-250

APPENDIX 4

PNEUMONIA SEVERITY OF ILLNESS (PSI) SCORING SYSTEM

Patient Characteristics	Points Assigned	Patient's Points
Demographic Factors		
• Age (in years)	age (in years)	
- Males	age (in years) -10	
- Females	+10	
• Nursing Home Resident	+30	
Comorbid Illness		
• Neoplastic Disease	+20	
• Liver Disease	+10	
• Congestive Heart Failure	+10	
• Cerebrovascular Disease	+10	
• Renal Disease	+10	
Physical Exam Findings		
• Altered Mental Status	+20	
• Respiratory Rate \geq 30/minute	+20	
• Systolic BP $<$ 90 mmHg	+20	
• Temperature $<$ 35°C or \geq 40°C	+15	
• Pulse \geq 125/minute	+10	
Laboratory Findings		
• pH $<$ 7.35	+30	
• BUN $>$ 10.7 mmol/L or creatinine $>$ 120 mmol/L	+20	
• Sodium $<$ 130 mmol/L	+20	
• Glucose $>$ 13.9 mmol/L	+10	
• Hematocrit $<$ 30%	+10	
• PO $<$ 60 mmHg or O ₂ sat $<$ 90%	+10	
• Pleural Effusion	+10	
TOTAL SCORE		

Risk Class	# of Points	Mortality (%)	Recommendation for Site of Care
I	< 50 yrs, no comorbidity, RR $<$ 24, normal BP, T \leq 38°C, P \leq 110	0.1	Outpatient
II	\leq 70 points	0.6	Outpatient
III	71-90 points	2.8	Generally outpatient
IV	91-130 points	8.2	Inpatient
V	$>$ 130 points	29.2	Inpatient

Reprinted from: Fine MJ, Auble TE, Yearly DM, et. al. A Prediction rule to identify low-risk patients with community acquired pneumonia. New England Journal of Medicine, 1997; 336: 243-250