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Community Acquired Pneumonia and The Emergency Physician

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Introduction

Pneumonia has remained the leading cause of infectious disease mortality in the United States for decades. Overall it is the 8th leading cause of death in the United States. There are roughly 6 cases per thousand persons per year and this incidence goes up significantly with increasing age (1). Mortality rates can approach 25% in elderly patients admitted to the intensive care unit (ICU). It is estimated that pneumonia costs the U.S. healthcare system in excess of \$9 billion each year and this figure does not include those patients treated in the outpatient setting (1,2).

Numerous medical societies have established guidelines for treatment of community-acquired pneumonia (CAP) such as the Infectious Disease Society of America (IDSA), the American Thoracic Society (ATS), and the British Thoracic Society (BTS). However, compliance with these guidelines in the emergency department (ED) setting is variable and is sometimes met with obstacles set forth by the Joint Commission (JC).

In caring for the emergency department (ED) patient with CAP the physician must be familiar with current guidelines and follow a data-based approach to care to limit mortality and decrease unnecessary healthcare costs. Studies have repeatedly shown cost and resource benefit to patients, without impacting outcome, for hospitals that routinely follow guideline-based care for CAP (3). There are many aspects to the care of the patient with CAP but it is essential to be cognizant of the following:

- Time to antibiotic dosing
- Use of clinical scoring systems such as the pneumonia severity index (PSI) and CURB-65
- Role of cultures and urinary antigens

- Definition and identification of patients requiring ICU level care
- The emerging importance of community-acquired MRSA (ca-MRSA) in CAP
- The IDSA recommendations for antibiotic therapy for the range of CAP patients
- The definition and importance of health-care associated pneumonia.

Time to Antibiotic Dosing

In 2004 the JC established time to antibiotic dosing as a core measure for hospitals. Core measures are a basis for hospitals throughout the country to be compared against one another and performance in meeting these measures can affect Medicare reimbursement. The JC pneumonia measure established four hours from ED arrival time as the benchmark for time to antibiotic dosing for patients who are suspected of having pneumonia. However, the evidence supporting this measure was insufficient to justify such a wide reaching mandate regarding antibiotic dosing for CAP (4, 5). Importantly, there were numerous consequences that resulted from this timeline. Hospitals shifted triage priority to patients who potentially could have pneumonia and emergency physicians were under the gun to provide antibiotics within four hours if they even suspected pneumonia was on the short list of potential diagnoses. A number of studies demonstrated that the “four-hour rule” had decreased ED accuracy of pneumonia diagnosis, increased exposure to unnecessary antibiotics, and increased antibiotic resistance all without affecting mortality (6, 7).

In 2007 the IDSA recognized the harm that the “four-hour rule” was causing and recommended simply that antibiotics be given to patients with pneumonia while the patient is still in the ED (1). The IDSA guideline was in part acknowledging the difficult task an emergency physician can sometimes face in establishing the diagnosis of CAP when a patient presents in an atypical fashion or has significant co-morbid illnesses that may cloud the diagnosis (e.g. COPD, CHF) (8). The emergency physician may even withhold antibiotics entirely if there is a diagnostic dilemma and the physician feels it is more appropriate for the inpatient team to determine whether antibiotics are warranted based upon further evaluation. The ED physician should document that a diagnostic dilemma existed at the time of inpatient disposition and the risks of inappropriate antibiotics outweighed benefits of empiric therapy. It is important to note these guidelines do not apply to patients with CAP who need admission to the ICU. Patients going to the ICU with CAP generally fall under the Surviving Sepsis guidelines which recommend antibiotics within the first hour of recognition of septic shock as mortality increases with each hour delay in administration of antibiotics (9).

Clinical Scoring Systems

Most emergency physicians are aware of the pneumonia severity index (PSI) and the CURB-65 scoring systems for patients with pneumonia. However, evidence suggests providers do not often employ these scoring systems as there is a broad spectrum of admission rates for CAP throughout the country (10).

There are numerous reasons for using scoring systems in CAP but the driving force is an attempt to reduce unnecessary admissions of low risk patients. Studies have shown that patients prefer outpatient therapy and those treated in the outpatient setting are more quickly able to return to normal activity. Additionally, it is estimated that the cost of inpatient treatment is up to 25 times higher than outpatient therapy.

The PSI was derived in 1989 and is intended to predict 30-day mortality for patients with CAP (11, 12). Patients are assigned points based upon a number of clinical variables (see table below) such as age, comorbid conditions, laboratory values and vital signs. Based on the score, patients fall into a category from I-V where a category I patient has a predicted 30-day mortality of 0.1% and a patient in the class V category has a predicted mortality of 27%. Unfortunately, this scoring system has historically been underutilized due to its time-consuming nature. However, it has been studied in a much broader array of clinical settings than the CURB-65 scoring system and with the ease of computer or smartphone The PSI was derived in 1989 and is intended to predict 30-day mortality for patients with CAP (11, 12). Patients are assigned points based upon a number of clinical variables (see table below) such as age, comorbid conditions, laboratory values and vital signs. Based on the score, patients fall into a category from I-V where a category I patient has a predicted 30-day mortality of 0.1% and a patient in the class V category has a predicted mortality of 27%. Unfortunately, this scoring system has historically been underutilized due to its time-consuming nature. However, it has been studied in a much broader array of clinical settings than the CURB-65 scoring system and with the ease of computer or smartphone applications in the ED, a quick PSI score can be quickly.

PSI variables	1. Age	1 point per year
	2. Sex	- 10 (if female)
	3. Nursing home resident	+ 10
	4. Neoplastic disease history	+ 30
	5. Liver disease	+ 20
	6. Heart failure	+ 10
	7. Renal disease	+ 10
	8. Cerebrovascular disease	+ 10
	9. Altered mental status	+ 20
	10. RR \geq 30	+ 20
	11. SBP < 90	+ 20
	12. Temp < 35.0°C	+ 15
	13. Temp > 39.9°C	+ 15
	14. HR \geq 125	+ 10
	15. pH < 7.35	+ 30
	16. BUN \geq 30	+ 20
	17. Sodium < 130	+ 20
	18. Glucose > 249	+ 10
	19. Hematocrit <30%	+ 10
	20. Pleural effusion	+ 10
	21. PaO ₂ < 60	+ 10

PSI score and 30-day mortality	Class I: 0-50 points 0.1% mortality Class II: 51-70 points 0.6% mortality Class III: 71-90 points 0.9% mortality Class IV: 91-130 points 9.3% mortality Class V: > 130 points 27.0% mortality
PSI class and suggested disposition	Class I: Outpatient Class II: Outpatient Class III: Observation as inpatient Class IV: Strongly consider ICU Class V: Strongly consider ICU

The CURB-65 scoring system is a much more user-friendly tool and can be applied readily within seconds to any patient who simply has a basic metabolic panel drawn as part of the assessment. Similar to the PSI, the CURB-65 is intended to predict 30-day mortality. The five components are Confusion (e.g. change from baseline or less than alert and oriented x 3), Uremia (BUN > 19 mg/dl), Respiratory rate \geq 30, Blood pressure (< 90 mm Hg systolic or \leq 60 mm Hg diastolic) and age \geq 65. One point is given for each component met by the patient and they are assigned a total score of 0-5 points. Patients with 0 points have a predicted 30-day mortality of 0.6% and those with 5 points have a predicted 30-day mortality of 57%. Disposition recommendations are based upon the point total.

CURB-65 points and estimated 30-day mortality	0 points: 0.6% mortality 1 point: 3.2% mortality 2 points: 13.0% mortality 3 points: 17.0% mortality 4 points: 41.5% mortality 5 points: 57.0% mortality
CURB-65 points and suggested disposition	0 points: Outpatient 1 point: Outpatient 2 point: Observation as inpatient 3 points: inpatient; consider ICU 4 points: Strongly consider ICU 5 points: Strongly consider ICU

Each clinical scoring system has been shown to reduce admissions if applied in the ED setting. The PSI system is slightly more sensitive for detecting low-risk patients that may be treated as outpatients but either scoring system is acceptable (13). The scoring systems are not for use in patients the clinician determines to be ill enough for admission to the ICU as clinical judgment always trumps these tools. The scoring systems are best utilized to identify stable patients that may be treated as outpatients instead of the medical/surgical floor. The physician may also be able to identify patients who have the potential for poor outcomes although appear to be clinically well appearing. In such circumstances, the physician may suspect the patient who appears to be appropriate for a medical/surgical bed but has a higher than

anticipated score on PSI or CURB-65 would prompt consideration for an ICU level of care. Finally, the scoring systems do not account for all clinical and social variables that sometimes need to be taken into consideration. Variables such as an unstable living situation, lack of follow up or financial resources for antibiotics, and psychiatric illness are not accounted for by the scoring systems and should be weighed by the clinician when deciding on appropriate disposition.

Severe CAP

The IDSA identifies two separate groups of CAP patients who warrant admission to the ICU . The first group is obvious to the physician and consists of those patients requiring mechanical ventilation or vasopressors. The second group, however, is less obvious and consequently a number of criteria have been established to help the physician identify these high-risk patients. The purpose is to ensure patients receive the appropriate level of care during the initial phases of their illness as the literature has demonstrated a higher mortality for patients who are transferred from the floor to the ICU as opposed to those patients who are sent directly from the ED to the ICU (14, 15). An additional benefit of identifying these ICU level patients is that the physician will be able to more accurately tailor the antibiotic coverage. The ATS modified criteria for patients with severe CAP that warrant ICU admission is detailed below (1):

Major Criteria (Need only one for ICU):

Invasive mechanical ventilation

Septic shock requiring vasopressors

Minor Criteria (Need ≥ 3 for ICU):

Respiratory rate ≥ 30

$\text{PaO}_2/\text{FiO}_2$ ratio ≤ 250

Multilobar infiltrates

Confusion/disorientation

Uremia ($\text{BUN} \geq 20 \text{ mg/dl}$)

Leukopenia ($\text{WBC count} < 4000 \text{ cells/mm}^3$)

Hypotension requiring aggressive fluid resuscitation

Hypothermia (core temperature $< 36^\circ\text{C}$)

Thrombocytopenia (platelet count $< 100,000 \text{ cells/mm}^3$)

The presence of any three minor criteria warrants ICU admission for the patient. However, in many clinical environments, an intensivist may not accept a patient to the ICU who has stable vital signs despite having confusion, uremia, and leukopenia (as an example of three minor criteria). The astute emergency physician may elect to observe that patient longer in the ED to determine if the patient is truly stable enough for a stepdown unit. Often times, patients will declare themselves within a few hours providing an opportunity for the emergency physician to reassess appropriate disposition. These criteria are set forth to identify patients who are likely to have an unstable hospital course and may well deteriorate in the next 12-24 hours requiring mechanical ventilation or vasopressors.

Blood Cultures

For years it was assumed that obtaining blood cultures on patients with pneumonia would add to the inpatient teams' ability to tailor an antibiotic regimen or identify unusual pathogens that would require a longer duration of treatment.

In a 2003 Canadian study investigators followed 760 blood cultures on admitted patients with a spectrum (i.e. PSI score I-V) of clinical illness due to pneumonia (16). Only 5.7% (43/760) of patients had positive blood cultures that were not regarded as contaminants. *Strep. pneumoniae* was the overwhelming pathogen (68.1%) grown out from culture with the remainder being accounted for mostly by *S. aureus* (11%) and *enterobacteriaceae* (16%). Most significantly, only 3 out of 760 patients (0.4%) were thought to benefit from the blood cultures through a change in management.

The likelihood of a false-positive blood culture is generally 5-8% which is very similar to the chance of obtaining a true positive blood culture in stable patients with CAP admitted to a medical/surgical floor (17). Most false positives are the result of gram positive skin flora such as *coagulase negative staphylococcus*. Since both *coagulase negative staphylococcus* and *staph. aureus* are identified as gram positive cocci in clusters initially, patients often are unnecessarily exposed to empiric vancomycin. In addition, a false positive blood culture is likely to add at least one day and significant cost to the patient's hospital stay.

In 2007 the IDSA revised their recommendations for blood cultures in an effort to curtail unnecessary and costly blood cultures for stable patients. They recommended blood cultures for patients who have severe CAP (i.e. likely admission to the ICU), cavitary infiltrates, leukopenia, history of alcoholism or cirrhosis, a pleural effusion, or who have functional (e.g. sickle cell anemia) or surgical asplenia (1). The potential for a positive blood culture is halved when the patient has received antibiotics prior to obtaining the culture. It is sometimes difficult for the emergency physician to know after the initial evaluation if the patient will require antibiotics, admission, and possibly blood cultures. Consequently, the emergency physician can always opt to draw blood cultures and choose not to send them immediately to the lab. Thus when enough clinical information becomes available to make the decision regarding antibiotics and admission there are already blood cultures available to be sent without having to delay antibiotic administration for another blood draw.

Sputum and Urinary Antigens

The basic principles of antibiotic therapy in CAP rest on the assumption that most cases will be the result of *strep. pneumoniae*, *haemophilus influenzae*, *legionella pneumophila*, *mycoplasma pneumoniae*, *chlamydomydia pneumonia* and viral pathogens. Consequently, the emergency physician does not often need to consider sputum or urinary antigen testing unless there is suspicion for another organism based

on host risk factors. The 2007 IDSA guidelines recommend targeted sputum and urinary antigen testing in the following circumstances:

Indication:	Sputum	Legionella antigen	Pneumococcal antigen
ICU admission	Yes	Yes	Yes
Cavitary infiltrates	Yes		
Failed outpatient antibiotics	Yes	Yes	Yes
Leukopenia			Yes
Active alcoholism	Yes	Yes	Yes
Severe liver disease			Yes
Severe obstructive/structural lung disease	Yes		
Asplenia (functional or surgical)			Yes
Pleural effusion		Yes	Yes
Recent travel		Yes	

**Blank areas in the above table reflect that there is no specific recommendation from the IDSA for that test and that co-morbid condition.*

Attempts to obtain the best quality sample are imperative (1). If the patient is intubated then deep aspiration is indicated. Respiratory therapy may also be utilized to try for an induced sample if the patient is able to cooperate. Unfortunately a large percentage of sputum samples in patients who are not intubated are inadequate (many squamous epithelial cells) or lead to growth of contaminants if not properly handled. It is not imperative that a sputum sample be obtained prior to antibiotic dosing as there is no evidence that a single antibiotic dose will affect the gram stain or culture.

Urinary antigen testing is not often of utility to the emergency physician as all CAP treatment will involve coverage of *Strep. Pneumoniae*, and *legionella pneumophila*. However, antigen testing may be of importance to the inpatient provider (i.e. may provide a definitive pathogen in the event the patient decompensates) and the results are available in a relatively expeditious fashion. The antigen tests (*Strep. Pneumoniae* and *legionella pneumophila*) are not affected by the initial dose of antibiotics so it is reasonable to allow the inpatient team to order these adjunctive tests.

Procalcitonin and C-Reactive Protein (CRP)

Numerous well designed trials have failed to show a benefit for antibiotics in mild to moderate exacerbations of COPD (18). However, the literature is less clear regarding severe exacerbations of COPD (i.e. warranting admission) and most of these patients are indeed treated with antibiotics. Asthmatics are also often treated empirically with antibiotics despite any evidence that treating asthmatic bronchitis with antibiotics improves outcome. Since COPD patients are likely to be seen repeatedly in the ED it is important to avoid unnecessary antibiotic use as eventually it is probable that CAP will be a

presentation and they may well have significant organism resistance to routine antibiotics. If the chest x-ray is non-diagnostic then the emergency physician is left to ponder the value of empiric antibiotics. However, recent literature suggests there may be value in sending a procalcitonin and CRP to help identify infectious from non-infectious etiology.

Procalcitonin is a precursor to calcitonin and is released in response to bacterial toxin production. Procalcitonin has been studied in trials attempting to determine if use of procalcitonin levels to guide therapy results in reductions in inappropriate antibiotic use. A meta-analysis demonstrated that using the procalcitonin level decreased antibiotic utilization and did not affect mortality or result in treatment failures (19). However, it should be noted that this laboratory test should only really be utilized in stable patients going to the floor in which there is a diagnostic quandary about infectious components to the presentation. There is no recommendation currently from the IDSA in regards to how best to use a procalcitonin level especially in regards to the ED setting.

C-reactive protein has been studied less extensively than procalcitonin for this purpose. Early literature suggests that CRP levels may not be as sensitive as procalcitonin for detecting bacterial infection. At the present time CRP should not be used in the ED for determination of bacterial pathogen involvement in disease presentation as it relates to asthma and COPD exacerbations.

Influenza

Whereas blood cultures, sputum, and urinary antigen testing have limited value to the emergency physician, influenza swabs are rapid and can prevent unnecessary antibiotic administration. The 2007 IDSA guidelines advocate liberal use of influenza testing during peak season as much for diagnostic purposes as it serves to allow the clinician to prescribe treatment to shorten symptom duration. In addition, there are hospital wide implications as patients with influenza need droplet isolation. High risk patients (see table below) who have documented influenza A or B should be treated with oseltamivir or zanamivir if the treatment is initiated within 48 hours of symptom onset (20). Unfortunately, the sensitivity of the most widely used tests varies from 50-70% meaning a negative result does not exclude influenza. If the patient is ill enough to warrant hospital admission and influenza is the clinical diagnosis, treatment with oseltamivir or zanamivir should be initiated regardless of the rapid influenza testing results. However, a low threshold to admit patients with influenza is not recommended as the ill, elderly population in the hospital is at highest risk for mortality from influenza (i.e. filling the hospital with influenza patients increases likelihood of transmission to other patients). The influenza vaccination is not 100% efficacious and it takes roughly two weeks to confer protection to the patient. Older patients and those with any immune deficiency are less likely to develop antibodies after vaccination. The influenza vaccination should be offered to all non-febrile ED patients at discharge during the fall and winter seasons if they do have any contraindications such as egg allergy or previous allergic reaction to the vaccination.

Patients who are considered high risk and warrant oseltamivir or zanamivir if begun within 48 hours of symptom onset:

1. Pregnant patients and women up to two weeks postpartum
2. Elderly (≥ 65 years of age)
3. Children < 2 years of age
4. Obese patients ($\text{BMI} \geq 40$)
5. Residents of nursing homes and other chronic care facilities
6. Native Americans and Alaska natives
7. Chronic medical conditions such as: active malignancy, pulmonary disease (including asthma), cardiovascular disease, chronic liver disease, chronic renal insufficiency, diabetes mellitus, immunosuppression (e.g. HIV), hemoglobinopathies (e.g. sickle cell anemia), neurologic conditions that impair respiratory defenses (e.g. seizure disorders)

Community-Acquired Methicillin-Resistant *Staph Aureus* (ca-MRSA) in CAP

Community-acquired MRSA has emerged in the past decade as a significant pathogen in skin and soft tissue infections. However, its role in CAP has yet to be adequately delineated. Case reports in the past few years have highlighted ca-MRSA as an aggressive and deadly pathogen in CAP often following infection with influenza. The first study attempting to define ca-MRSA epidemiology in CAP was published in 2012 (21). Twelve academic centers pan-cultured patients with CAP and sent their specimens to the CDC for further analysis. Unfortunately only 102/627 (17%) patients had a pathogen identified by blood or sputum cultures. Of these, 14/102 (13.7%) were found to be ca-MRSA. Granted the sample size was small, but the authors noted that the patients with ca-MRSA tended to have a higher mortality (2/14 died) and morbidity as 5/14 required ICU care. Investigators noted that the group of patients who were more likely to have ca-MRSA as a pathogen had an increased incidence of cirrhosis, history of ca-MRSA, recent admission to a long-term care facility and household contacts with skin and soft tissue infections.

The IDSA guidelines in 2007 strongly recommend considering empiric vancomycin for all patients who have severe CAP. While the guidelines acknowledge there is little evidence to support this recommendation, they state the ca-MRSA strains are more likely to carry the gene for Panton-Valentine leukocidin which produces a toxin linked to necrotizing pneumonia, shock, and respiratory failure. Ca-MRSA is more likely to be identified in blood or sputum samples than other pathogens allowing the inpatient team to appropriately tailor antibiotics as needed throughout the hospital course. The

potential for significant morbidity and mortality with ca-MRSA in severe CAP makes the decision to administer one dose of vancomycin in the ED relatively straightforward as the inpatient care team may always choose to terminate this therapy as appropriate.

Preventing Ventilator Associated Pneumonia

When patients in the ED end up requiring treatment in the ICU they are at risk for numerous hospital-acquired complications that contribute to overall morbidity and mortality. Ventilator associated pneumonia (VAP) is at the top of the list of ICU complications and in the past few decades studies have attempted to define interventions that can be done to decrease the incidence of VAP. While many emergency physicians do not envision that they play a role in VAP, it is important to recognize that some early measures may affect the patient's likelihood for eventual VAP.

Endotracheal intubation increases the likelihood of developing pneumonia anywhere from 6-21 times in comparison to the non-intubated patient in the inpatient setting. However, the literature is far from conclusive in delineating which interventions will decrease the incidence of VAP. Interventions such as head of bed elevation, supraglottic aspiration, silver-coated endotracheal tubes, probiotics, topical antimicrobials, systemic antibiotics, and oropharyngeal decontamination have all been investigated without robust results. Many of these interventions do result in decreased incidence of VAP but fail to show mortality benefit at 28 days and may be linked to increased antimicrobial resistance (22). For the emergency physician, the most prudent intervention would be to make a concerted effort to avoid endotracheal intubation and the associated morbidity and mortality that results. The evidence on the effectiveness of non-invasive ventilation for preventing intubation is robust for diseases such as CHF, COPD, and asthma if this intervention is implemented rapidly in the ED during the initial phases of the disease process. The available literature does not support routinely using VAP prevention modalities in the ED at the present time for a mortality benefit. That being said, many of these interventions are undoubtedly employed in your hospital's ICU setting and if your ED regularly has patients boarding for ICU beds, it would be prudent to collaborate with the ICU to employ algorithms of care for these vented patients in the ED.

Antibiotic Selection

Perhaps the most important role of the emergency physician in management of CAP is antibiotic stewardship. The inappropriate use of broad-spectrum antibiotics has led to antibiotic resistance, increased incidence of *C. difficile* infections, and increased healthcare costs (1). One of the major contributors to this problem is the widespread use of fourth-generation fluoroquinolones such as moxifloxacin and levofloxacin for outpatient CAP. Practitioners need to be cognizant of the 2007 IDSA guidelines and adhere to these recommendations in an effort to save the broad-spectrum antibiotics for those patients who really need them in the hospital.

Outpatient CAP treatment without risk of Drug-Resistant *S. pneumoniae*

Previously healthy patients who do not have risk factors for drug-resistant *S. pneumoniae* (see table below) fall into the lowest risk category. The 1st line recommendation for these patients is a macrolide (e.g. azithromycin, clarithromycin, or erythromycin), however doxycycline is considered an acceptable alternative if the patient has a macrolide allergy. Duration of therapy should be a minimum of five days and the patient should be afebrile for 48-72 hours before discontinuation of therapy. Because azithromycin has a longer half-life, the standard 5-day course of therapy is acceptable for this antibiotic; the physician should consider a 7-day course of therapy when using other 1st line agents.

Outpatient CAP Treatment with risk of Drug-Resistant *S. pneumoniae*

Outpatient treatment for patients who have risk factors for drug-resistant *S. pneumoniae* requires a respiratory fluoroquinolone (e.g. moxifloxacin, levofloxacin, or gemifloxacin) or dual therapy combining a β -lactam plus a macrolide. It is important to note that ciprofloxacin is not a respiratory fluoroquinolone and should not be used in the treatment of CAP. Respiratory fluoroquinolones have activity against the so called atypical pathogens such as *Legionella pneumophila*, *Mycoplasma pneumoniae*, and *Chlamydia pneumoniae* as do macrolides and doxycycline but β -lactam antibiotics do not which is the reason for the dual coverage. Risk factors for drug-resistant *S. pneumoniae*:

- Chronic Disease: cardiac, pulmonary, hepatic, or renal
- Diabetes Mellitus
- Alcoholism
- Asplenia: surgical or functional (e.g. sickle cell anemia, cirrhosis)
- Malignancy
- Immunocompromised condition (e.g. HIV, immunosuppressant use)
- Use of antimicrobials within last 90 days (i.e. select agent from another class)

The duration of therapy should once again be a minimum of 5 days and the patient should be afebrile for at least 48-72 hours prior to cessation of antibiotic therapy. Since the emergency physician will not be able to follow the patient's fever pattern as an outpatient it is reasonable to treat the patient for 7-10 days. Most emergency physicians will undoubtedly elect to treat the patient with the simpler one-drug regimen utilizing a fluoroquinolone but should keep in mind that fluoroquinolones will inhibit warfarin metabolism and may cause a dangerous elevation in the patient's international normalized ratio (INR). Both macrolides and fluoroquinolones prolong the QT interval which is important to consider if patients are on other medications that also prolong the QT interval such as antipsychotics or methadone.

Inpatient CAP non-ICU Treatment

Patients who are admitted to the hospital with CAP but are not ill enough for ICU level of care have two equally efficacious treatment options. The provider may select either a respiratory fluoroquinolone or a

β -lactam plus a macrolide. Acceptable β -lactams include ceftriaxone, cefotaxime, and ampicillin. If the patient had been exposed to either a fluoroquinolone, a β -lactam, or a macrolide antibiotic in the past 90 days then it is appropriate to avoid that antibiotic due to the potential for resistance. Doxycycline is an acceptable alternative for those patients with a macrolide allergy. Initial therapy should begin with an intravenous route of administration. An important consideration is the patient with multiple allergies including potentially both penicillin and fluoroquinolones. Only 10% of patients who have a true penicillin allergy also will have an allergy to cephalosporins (23,24). Those patients who have a minor reaction to penicillin such as rash or itching (not recommended if patient had anaphylaxis to penicillin) may be an excellent candidate for a trial of a cephalosporin since they will be admitted to the hospital.

Inpatient CAP ICU Treatment

The recommended treatment for the patient admitted to the ICU is a β -lactam plus either azithromycin or a fluoroquinolone. For those patients with a penicillin allergy a fluoroquinolone plus aztreonam is the preferred regimen. The reason a fluoroquinolone is not recommended as monotherapy is due to a 2005 study in which a fluoroquinolone as monotherapy resulted in a trend towards worse outcomes (unclear reasons) (15). *Pseudomonas aeruginosa* should be considered as a potential pathogen in patients who have structural lung disease (e.g. bronchiectasis, cystic fibrosis), a history of *pseudomonas* respiratory infection, frequent steroid use for COPD exacerbations, and recent previous hospitalization. In these cases patients should receive double-coverage for potential *pseudomonas* infection with an antipneumococcal, antipseudomonal β -lactam (piperacillin-tazobactam, cefepime, imipenem or meropenem) plus either levofloxacin or ciprofloxacin. An alternate regimen would be substituting an aminoglycoside and azithromycin for the fluoroquinolone. *Methicillin-resistant S. aureus* (both community and hospital acquired) is a growing concern as a pathogen in CAP and warrants strong consideration for empiric vancomycin added to the above regimen whenever a patient has end-stage renal disease, a history of injection drug use, prior antibiotic therapy (especially with fluoroquinolones), a history of *MRSA* skin and soft tissue infections, or a preceding influenza infection.

Outpatient low risk for drug-resistant <i>S. Pneumoniae</i>	Outpatient high risk for drug-resistant <i>S. Pneumoniae</i>	Inpatient non-ICU	Inpatient ICU
1 st Line: Macrolide	1 st line: Fluoroquinolone 1 st line: β -lactam plus macrolide	1 st line: Fluoroquinolone 1 st line: β -lactam plus macrolide	1 st line: β -lactam plus azithromycin or fluoroquinolone
2 nd line: Doxycycline			PCN allergic: Aztreonam plus fluoroquinolone

**ICU level patients deserve strong consideration of vancomycin for possible s. aureus*

***Consider Pseudomonas aeruginosa (and double-cover with agents described above) in those with structural lung disease (e.g. bronchiectasis, cystic fibrosis), a history of pseudomonas respiratory infection, frequent steroid use for COPD exacerbations, and recent previous hospitalization*

Health-care Associated Pneumonia (HCAP)

Health-care associated pneumonia is an underappreciated category of pneumonia patients that have higher morbidity and mortality than patients with CAP (25). Patients with HCAP are at risk for more virulent and resistant bacteria and warrant broad spectrum antibiotics that differ significantly from what is required for patients with CAP. HCAP is defined as pneumonia that occurs in a non-hospitalized patient that has had extensive contact with the healthcare system (see table below). Patients with HCAP are more likely to have gram negative pathogens (including *pseudomonas*) and *staph aureus* and less likely to have *strep pneumoniae* or atypical pathogens as etiologies for their pneumonia. The importance to the emergency physician is highlighted by the Zilberburg study in 2008 which revealed a significant mortality benefit for patients receiving appropriate antibiotic coverage in the ED (26). Patients who received appropriate antibiotics had an 18% mortality versus 30% mortality in those initially not covered with sufficient broad spectrum antibiotics. Another study revealed a dismal rate of knowledge of recommended IDSA guidelines for HCAP therapy. Only 9% of physicians in a 2009 survey accurately identified a guideline-appropriate regimen for HCAP whereas 78% of physicians knew the proper antibiotics for CAP (27).

In 2005 the ATS and IDSA published guidelines for hospital-acquired pneumonia (HAP), ventilator-associated pneumonia (VAP), and HCAP (25). The three entities of HAP, VAP, and HCAP are discussed concurrently because many of the same pathogens are involved in these disease processes. A key point in these guidelines is that multi-drug resistant (MDR) bacteria (mostly gram negative organisms) may be involved which necessitates double-coverage of these pathogens such as *klebsiella*, *serratia*, *acinetobacter*, *E. coli*, *enterobacter species*, and *pseudomonas*. The table below outlines suggested antibiotic regimens for the patient with pneumonia and risk factors for HCAP. The goal is to adequately cover potential pathogens until the inpatient team has the time to thoroughly review the patient's chart, risk factors for HCAP and MDR bacteria, and previous microbiologic data to determine appropriate antibiotic coverage. Because these patients may receive broad spectrum antibiotics for a number of days this places significant importance on obtaining all available specimens in an effort to identify the pathogen including blood cultures, sputum cultures, and urinary antigens.

HCAP Risk Factors	<ol style="list-style-type: none"> 1. Intravenous therapy, wound care, or intravenous chemotherapy within past 90 days 2. Residence in a nursing home or other long-term care facility 3. Hospitalization in an acute care hospital for two or more days in the last 90 days 4. Attendance at a hospital or hemodialysis clinic in the last 30 days
2005 IDSA/ATS Antibiotic Guideline for HCAP	<ol style="list-style-type: none"> 1. Vancomycin or linezolid for <i>s. aureus</i> coverage PLUS 2. Antipseudomonal cephalosporin (ceftazidime or cefepime) or Antipseudomonal carbapenem (imipenem or meropenem) or β-lactam/β-lactamase inhibitor (piperacillin-tazobactam) PLUS 3. Antipseudomonal fluoroquinolone (ciprofloxacin or levofloxacin) or Aminoglycoside (gentamicin, amikacin, or tobramycin)

Conclusion

In the past decade the management of CAP has changed considerably for the emergency physician. A diagnosis and the administration of antibiotics used to be sufficient for the purposes of the ED visit but now the expectations have transformed the role of the provider. Now, the emergency physician must weigh the possibility of ca-MRSA, the risk factors for HCAP, the role of influenza, utility of blood cultures, and determine the appropriate antibiotics for the patient at hand as it is no longer a once size fits all paradigm. The emergency physician has also become a vital gatekeeper of the hospital and must judiciously use the inpatient resources by recognizing and treating low-risk CAP in the outpatient setting through the application of clinical scoring systems. Through diligent attention to the patient with CAP it is a realistic goal to see an increase in the quality of care for these patients in the coming decade and beyond.

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