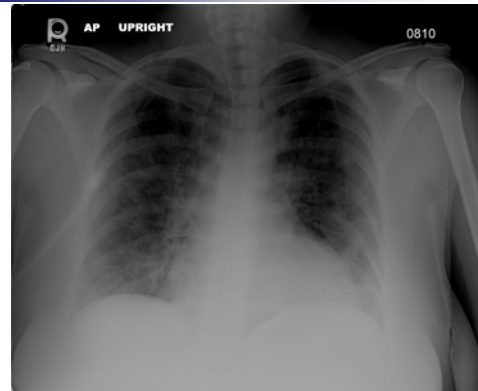


PNEUMONIA: Variations and Interventions Always a Challenge

CURE Activity February 9, 2010

William Guest, MD, FCCP
Assistant Dean of Curriculum
School of Medicine – SW Campus
Medical College of Georgia



- Definition/Diagnosis – a new or progressive infiltrate on radiograph associated with clinical findings of fever, increased respiratory secretions, cough, shortness of breath, and sometimes chest discomfort and possibly blood-tinged sputum
- Physical exam – tachypnea, tachycardia, abnormal breath sounds including asymmetry, crackles, wheezing, use of accessory muscles, and possibly cyanosis, dullness to percussion, vocal fremitus, hypotension

Pneumonia

Sputum



2006 Pneumonia Statistics

- 4,000,000 cases per year of CAP – most Rx'd as outpatients
- 1,200,000 Americans hospitalized with pneumonia
 - 55,477 died secondary to pneumonia
- USA costs estimated \$9-10 billion
- Globally > 4,000,000 deaths per year
 - ½ of these deaths occur in children under age 5

Harrison's Principles of Internal Medicine 17th edition 2008 1619

Pneumonia

Risk Factors for Pneumonia

- Age < 5, > 65
- Underlying lung disease: asthma, COPD
- Tobacco abuse
- Alcoholism
- Decreased mentation
 - loss of consciousness, seizures, sedation, cerebrovascular disease
- Immunosuppression
 - steroids, chemotherapy, HIV

Pneumonia

Pathophysiology:

- Pathogens reach the alveolar spaces
- Macrophages kill and engulf the organisms
- Once macrophages overwhelmed –pneumonia
- Host releases inflammatory response: interleukin (IL), tumor necrosis factor (TNF)
- Chemokines stimulate release of neutrophils

Hypoxemia:

- Common cause of acute respiratory failure
- #1 cause of ARDS
- Common cause of sepsis/septic shock

Harrison's Principles of Internal Medicine 17th edition 2008 1619-1628

Pneumonia



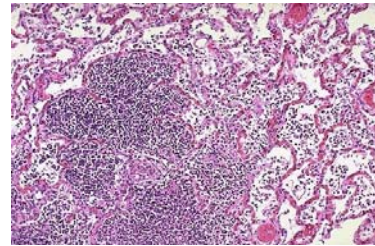
Utah Medical Library WebPath Lung 005

Pneumonia



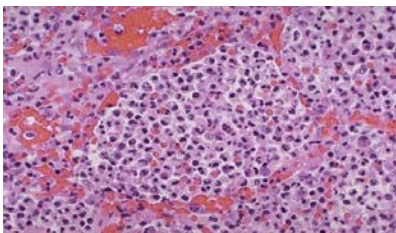
Utah Medical Library WebPath Lung 006

Pneumonia



Utah Medical Library WebPath Lung 015

Pneumonia



Utah Medical Library WebPath Lung 016

Pneumonia

- Primary – Inhalation of the etiologic agent
- Secondary – hematogenous spread to the lungs from another source
- Direct extension – mediastinitis, penetrating trauma

Harrison's Principles of Internal Medicine 17th edition 2008 1619-1628

Pneumonia

Classifications

- Infectious vs. Noninfectious
- Acute vs. Chronic
- Typical vs. Atypical

Pneumonia

Infectious Etiologies

- Bacteria
- Viruses
- Fungi
- Protozoa

Noninfectious Etiologies

- Chemical inhalation
- Drugs
- Radiation
- Post obstructive neoplastic (benign & malignant)
 - foreign body
- Others
 - Cryptogenic alveolitis
 - Alveolar hemorrhage syndromes

Pneumonia

Atypical Infectious Pneumonia Etiologies -Common

- Viral (influenza, adenovirus, respiratory syncytial virus)
- Legionella pneumophila
- Hemophilus influenza
- Mycoplasma pneumoniae
- Chlamydia pneumoniae
- Pneumocystis jiroveci
- Fungal (cryptococcus neoformans, histoplasma capsulatum)

Pneumonia

Atypical Infectious Pneumonia Etiologies -Less Common

Mycobacterial

TB Complex

- M.tuberculosis
- M.bovis
- M.microti
- M.africanum

Atypical TB

- M.avium intracellulare
- M.chelonae
- M.fortuitum
- M.gordonae
- M.kansasii

Pneumonia



Atypical Infectious Pneumonia Etiologies -Less Common (continued)

- Francisella tularensis (tularemia)
- Bordetella pertussis (pertussis)
- Yersenia pestis (plague)
- Actinomyces
- Nocardia
- Chlamydia psittaci (psittacosis)

Pneumonia

Clinical Features of Atypical Pneumonias

- More nonproductive cough
- Less purulent phlegm, mainly clear
- Rarely blood-tinged
- Low grade fever
- Headache
- Myalgias
- Nausea
- Less leukocytosis
- If present, small pleural effusions

Pneumonia

Aspiration Pneumonia

- Occult or gross
- Liquid or solid particle aspiration
- Chemical pneumonitis
- Microbiology: mixed flora including anaerobes
- Risk factors: sedation, neurologic disorders, esophageal motility disorders

Pneumonia

- CAP - community acquired pneumonia
- HCAP - healthcare acquired pneumonia
- HAP – hospital acquired pneumonia
- VAP – ventilator acquired pneumonia

Pneumonia

HCAP – 2 or more days admitted to an acute care facility within 90 days, or resided in nursing home, or received IV antibiotics, chemotherapy or wound care within 90 days

HAP – pneumonia which occurs 48 hours or more following admission, not incubating at time of admission

VAP – pneumonia which occurs 48-72 hours following intubation and mechanical ventilation, not incubating or present at time of initiation of ventilatory support

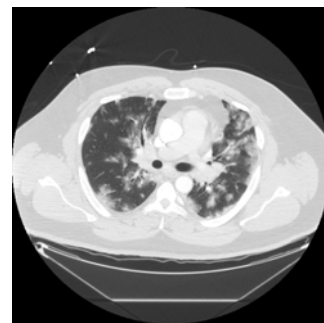
AJRCCM vol 171 388-416 2005

Pneumonia

Factors Which Aid in Identification of Etiologic Cause

- History
- Sputum appearance, quantity, stains, cultures
- Blood cultures
- Urinary antigens
- Radiographic patterns on chest x-ray
- Bronchoscopy specimens
- Polymerase chain reaction (PCR) studies
- Serology studies
- Procalcitonin

Pneumonia



Pneumonia

Respiratory Infection Panel

- *Acinetobacter baumannii* Influenza A – H1N1-09 *Pseudomonas aeruginosa*
- Adenovirus types 3, 4, 7, 21 Influenza B Respiratory syncytial virus A
- *Chlamydomphila pneumoniae* *Klebsiella pneumoniae* Respiratory syncytial virus B
- Coxsackie viruses *Legionella pneumophila* Rhinoviruses
- Echoviruses MRSA *Staphylococcus aureus*
- *Haemophilus influenzae* *Mycoplasma pneumoniae* *Streptococcus pneumoniae*
- Human metapneumovirus *Neisseria meningitis* *Streptococcus pyogenes*
- Influenza A – Human Influenza Parainfluenza virus type 1, 2, 3, 4

Diatherix Laboratories
Pneumonia

Viral Respiratory Panel

- Adenovirus types 3, 4, 7, 21 Influenza A – Human Influenza Respiratory syncytial virus A
- Coxsackie viruses Influenza A – H1N1-09 Respiratory syncytial virus B
- Echoviruses Influenza B Rhinoviruses
- Human metapneumovirus Parainfluenza virus type 1, 2, 3, 4

Diatherix Laboratories
Pneumonia

Procalcitonin

- Usually undetectable in healthy individuals
- Slightly increased in viral and noninfectious inflammatory responses
- Significantly elevated in bacterial infections
50 – 74 % sensitive
- Possible guide for outpatient decision making

P. Munoz et al, Diagnostic Microbiology and Infectious Disease Vol 49 Iss 4 pp 237-241
Pneumonia

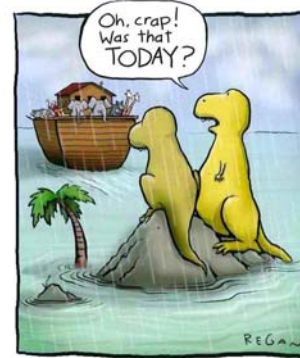


Table 6. Most common etiologies of community-acquired pneumonia.

| Patient type | Etiology |
|---------------------|---|
| Outpatient | <i>Streptococcus pneumoniae</i> <i>Mycoplasma pneumoniae</i> <i>Haemophilus influenzae</i> <i>Chlamydomphila pneumoniae</i> Respiratory viruses* |
| Inpatient (non-ICU) | <i>S. pneumoniae</i> <i>M. pneumoniae</i> <i>C. pneumoniae</i> <i>H. influenzae</i> <i>Legionella</i> species Aspiration Respiratory viruses* |
| Inpatient (ICU) | <i>S. pneumoniae</i> <i>Staphylococcus aureus</i> <i>Legionella</i> species Gram-negative bacilli <i>H. influenzae</i> |

ISDAVATS GUIDELINES FOR CAP IN ADULTS/ CID 2007:44 (SUPPL 2)
Pneumonia

Table 8. Epidemiologic conditions and/or risk factors related to specific pathogens in community-acquired pneumonia.

| Condition | Commonly encountered pathogen(s) |
|--|--|
| Alcoholism | <i>Streptococcus pneumoniae</i> , oral anaerobes, <i>Klebsiella pneumoniae</i> , <i>Acinetobacter</i> species, <i>Mycobacterium tuberculosis</i> |
| COPD and/or smoking | <i>Haemophilus influenzae</i> , <i>Pseudomonas aeruginosa</i> , <i>Legionella</i> species, <i>S. pneumoniae</i> , <i>Moraxella catarrhalis</i> , <i>Chlamydomphila pneumoniae</i> |
| Aspiration | Gram-negative enteric pathogens, oral anaerobes |
| Long abscess | CA-MRSA, oral anaerobes, endemic fungal pneumonia, <i>M. tuberculosis</i> , atypical mycobacteria |
| Exposure to bat or bird droppings | <i>Histoplasma capsulatum</i> |
| Exposure to birds | <i>Chlamydomphila psittaci</i> (if poultry avian influenza) |
| Exposure to rabbits | <i>Francisella tularensis</i> |
| Exposure to farm animals or parturient cats | <i>Coccidia</i> (if feral) |
| HIV infection (early) | <i>S. pneumoniae</i> , <i>H. influenzae</i> , <i>M. tuberculosis</i> |
| HIV infection (late) | The pathogens listed for early infection plus <i>Pneumocystis jirovecii</i> , <i>Cryptococcus</i> , <i>Histoplasma</i> , <i>Aspergillus</i> , atypical mycobacteria (especially <i>Mycobacterium kansasii</i>), <i>P. aeruginosa</i> , <i>H. influenzae</i> |
| Hotel or cruise ship stay in previous 2 weeks | <i>Legionella</i> species |
| Travel to or residence in southwestern United States | <i>Coccidioides</i> species, <i>Hantavirus</i> |
| Travel to or residence in Southeast and East Asia | <i>Burkholderia pseudomallei</i> , avian influenza, SARS |
| Influenza active in community | Influenza, <i>S. pneumoniae</i> , <i>Staphylococcus aureus</i> , <i>H. influenzae</i> |
| Cough >2 weeks with whoop or posttussive vomiting | <i>Bordetella pertussis</i> |
| Structural lung disease (e.g., bronchiectasis) | <i>Pseudomonas aeruginosa</i> , <i>Burkholderia cepacia</i> , <i>S. aureus</i> , <i>S. pneumoniae</i> , <i>M. tuberculosis</i> , <i>S. pneumoniae</i> |
| Injection drug use | <i>Burkholderia pseudomallei</i> , avian influenza, SARS |
| Endobronchial obstruction | Anaerobes, <i>S. pneumoniae</i> , <i>H. influenzae</i> , <i>S. aureus</i> |
| In contact of bioterrorism | <i>Bacillus anthracis</i> (aerodispersible), <i>Yersinia pestis</i> (plague), <i>Francisella tularensis</i> (tularemia) |

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Pneumonia

Community Acquired Pneumonia

- Outpatient versus inpatient therapy
 - Oxygenation status
 - Vital signs
 - Mentation
 - Co-morbidities
 - Social support systems
 - Multiple pulmonary lobes involved radiographically
- Commonly utilized therapy
 - Outpatient
 - Macrolide
 - Respiratory fluoroquinolone
 - Inpatient, non-ICU
 - β lactam plus macrolide
 - Respiratory fluoroquinolone

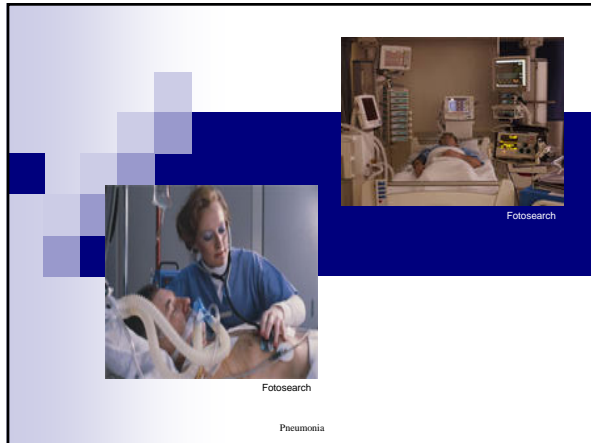
Pneumonia

Table 4. Criteria for severe community-acquired pneumonia.

- Minor criteria^a
- Respiratory rate^b \geq 30 breaths/min
 - PaO₂/FiO₂ ratio^b \leq 250
 - Multilobar infiltrates
 - Confusion/disorientation
 - Uremia (BUN level, \geq 20 mg/dL)
 - Leukopenia^c (WBC count, $<$ 4000 cells/mm³)
 - Thrombocytopenia (platelet count, $<$ 100,000 cells/mm³)
 - Hypothermia (core temperature, $<$ 36°C)
 - Hypotension requiring aggressive fluid resuscitation
- Major criteria
- Invasive mechanical ventilation
 - Septic shock with the need for vasopressors

IDSA/ATS GUIDELINES FOR CAP IN ADULTS/ CID 2007:44 (SUPPL 2)

Pneumonia



Pneumonia

- HAP
 - 2nd most common nosocomial infection USA
 - Increases LOS 7-9 days
 - Excess costs upwards of \$40,000/patient
 - Source of 20-25% of all ICU infections
- VAP
 - Previously reported to occur in 9-27% of intubated patients
 - Increase risk early in ventilator use --3%/day first 5 days
 - Intubation itself is a risk factor
 - Less with NIPPV

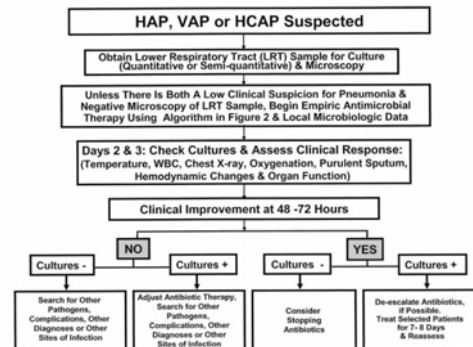
AJRCCM vol 171 388-416 2005

Pneumonia

TABLE 4. INITIAL EMPIRIC THERAPY FOR HOSPITAL-ACQUIRED PNEUMONIA, VENTILATOR-ASSOCIATED PNEUMONIA, AND HEALTHCARE-ASSOCIATED PNEUMONIA IN PATIENTS WITH LATE-ONSET DISEASE OR RISK FACTORS FOR MULTIDRUG-RESISTANT PATHOGENS AND ALL DISEASE SEVERITY

| Potential Pathogens | Combination Antibiotic Therapy* |
|---|---|
| Pathogens listed in Table 3 and MDR pathogens: <i>Pseudomonas aeruginosa</i> <i>Klebsiella pneumoniae</i> (ESBL*) [†] <i>Acinetobacter</i> species [†] | Antipseudomonal cephalosporin (cefepime, ceftazidime) or Antipseudomonal carbapenem (meropenem or imipenem) or β -Lactam/ β -lactamase inhibitor (piperacillin-tazobactam) plus Antipseudomonal fluoroquinolone [†] (ciprofloxacin or levofloxacin) or Aminoglycoside (amikacin, gentamicin, or tobramycin) plus Methicillin-resistant <i>Staphylococcus aureus</i> (MRSA) <i>Legionella pneumophila</i> [†] |
| | Linezolid or vancomycin [†] |

AMERICAN JOURNAL OF RESPIRATORY AND CRITICAL CARE MEDICINE, VOL 171, p. 402
Pneumonia



AMERICAN JOURNAL OF RESPIRATORY AND CRITICAL CARE MEDICINE, VOL 171, p. 398
Pneumonia

Modifiable Risk Factors for Ventilated Patients:

- Hand hygiene
- Monitor/early removal of invasive devices
- Daily spontaneous breathing trials if appropriate
- Limit paralytic drug use
- HOB elevated 45°
- Avoid "breaks" in the ventilator circuit
- Keep cuff pressures > 20 cmH2O
- Avoid nasotracheal intubation
- Increase unit staffing
- Limit "trips" outside ICU
- ?? silver lined ET tubes

Pneumonia

HAP & VAP

- Each has a mortality of 30-50%
- Worse with bacteremia
- Worse with Pseudomonas, Acinetobacter
- Worse with medical vs. surgical illness
- Worse with delay or ineffective antibiotics

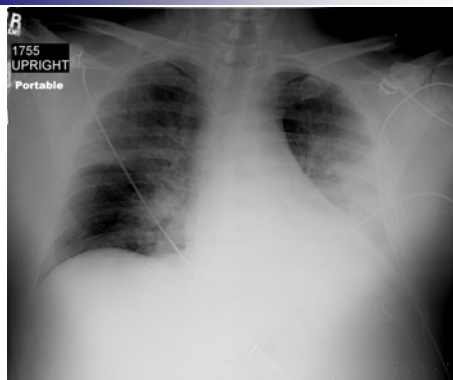
AJCCM vol 171 388-416 2005

Pneumonia

Other Considerations of Care

- Always consider patient's desires
 - DNR, DNI, Advance Directives
- Avoid transfusions in non-bleeding patients with hemoglobin > 7
- Use "new blood" if possible (blood < 14 days old)
- Glucose control 140 – 180 range
 - ICU no longer "tight control" 80 - 110
- Use GI tract to avoid villous atrophy
 - translocation bacterial infections
- DVT prophylaxis
- H2 blocker vs. PPI for gastric stress prophylaxis

Pneumonia



Pneumonia

- Parapneumonic effusion/empyema
 - Size of effusion
 - Symptoms related to effusion (respiratory rate, oxygenation, pain)
 - Persistent fever or reoccurrence of fever
 - Thoracentesis
 - Contraindications – lack of consent, coagulopathy, marked thrombocytopenia
 - Exudate
 - Pleural TP/serum TP > .5
 - Pleural LDH/serum LDH > .6
 - Pleural LDH > 200
 - Pleural pH < 7.2
 - Empyema
 - WBC > 25,000, organisms seen on smear, + culture, markedly low glucose
 - Thoracostomy drainage recommended for all empyemas and pleural pH < 7.2

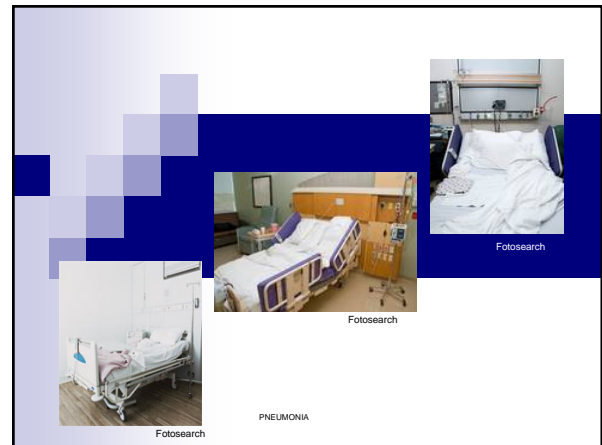
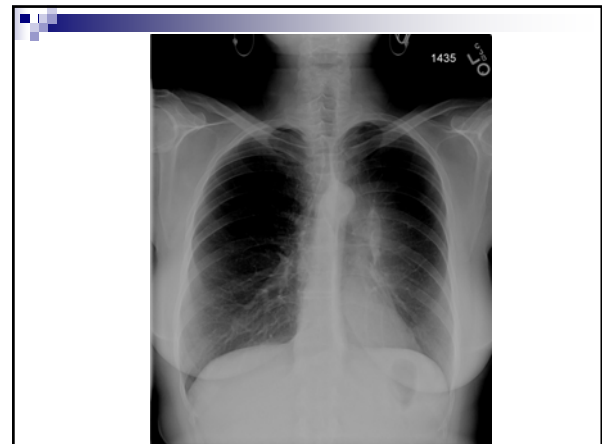
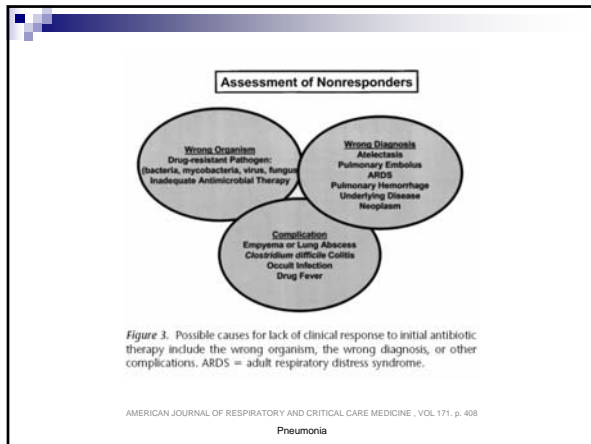
Pneumonia

Table 10. Criteria for clinical stability.

Temperature ≤37.8°C
 Heart rate ≤100 beats/min
 Respiratory rate ≤24 breaths/min
 Systolic blood pressure ≥90 mm Hg
 Arterial oxygen saturation ≥90% or pO₂ ≥60 mm Hg on room air
 Ability to maintain oral intake^a
 Normal mental status^a

IDSA/ATS GUIDELINES FOR CAP IN ADULTS/ CID 2007:44 (SUPPL 2)

Pneumonia



- ### Core Measures for Pneumonia
- Time of initiation of antibiotics (< 6 hours)
 - Blood cultures prior to antibiotics
 - Vaccines
 - Smoking cessation education
- * previously oximetry measurement of oxygenation status was required. >99% compliance--now expected but not monitored/reported
- Pneumonia

Diagnoses – DRG's 193, 194, 195

| DRG | DRG Description | CC/MCC | DRG WT |
|-----|--|---|--------|
| 195 | Simple Pneumonia & Pleurisy Without CC/MCC => | No CC/MCC | 0.7095 |
| 194 | Simple Pneumonia & Pleurisy With CC => | Hyponatremia | 0.9976 |
| | | Chronic Systolic CHF | |
| | | Alzheimer's Dementia w/ Behavioral Disturbance | |
| | | Acute blood loss Anemia | |
| | | Morbid Obesity w/ BMI >40 | |
| | | Malignant Hypertension | |
| | | Chronic Renal Failure Stage IV – V – ESRD | |

DRG Reimbursement = DRG Weight X Medicare Hospital Base Rate

Pneumonia

Diagnoses – DRG's 193, 194, 195

| DRG | DRG Description | CC/MCC | DRG WT |
|-----|---|-------------------------------------|--------|
| 193 | Simple Pneumonia & Pleurisy With MCC => | Acute on Chronic Systolic CHF | 1.4378 |
| | | Acute Renal Failure | |
| | | Decubitis Ulcer Stage III and IV | |
| | | Acute Respiratory Failure | |
| | | Septicemia due to | |
| | | Severe Protein Calorie Malnutrition | |
| | | Pulmonary Embolism | |

DRG Reimbursement = DRG Weight X Medicare Hospital Base Rate

Pneumonia

Diagnoses – DRG's 177, 178, 179

| DRG | DRG Description | CC/MC | DRG WT |
|-----|--|--|--------|
| 179 | Respiratory Infections & Inflammation Without CCMCC | No CC or MCC | 1.0088 |
| 178 | Respiratory Infections & Inflammation with CC => | Hyponatremia | 1.486 |
| | | Chronic Systolic CHF | |
| | | Alzheimer's Dementia w/ Behavioral Disturbance | |
| | | Acute blood loss Anemia | |
| | | Morbid Obesity w/ BMI > 40 | |
| | | Malignant Hypertension | |
| | | Chronic Renal Failure Stage IV – V - ESRD | |

DRG Reimbursement = DRG Weight X Medicare Hospital Base Rate

Pneumonia

Diagnoses – DRG's 177, 178, 179

| DRG | DRG Description | CC/MCC | DRG WT |
|-----|---|-------------------------------------|--------|
| 177 | Respiratory Infections & Inflammation with MCC => | Acute on Chronic Systolic CHF | 2.0483 |
| | | Acute Renal Failure | |
| | | Decubitis Ulcer Stage III and IV | |
| | | Acute Respiratory Failure | |
| | | Septicemia due to | |
| | | Severe Protein Calorie Malnutrition | |
| | | Pulmonary Embolism | |

DRG Reimbursement = DRG Weight X Medicare Hospital Base Rate

Pneumonia

Pneumonia Average Length of Stay (ALOS) for 2009 - Medicare Only

| DRG | TRMC ALOS | Medicare DRG ALOS | TRMC DRG ALOS | * National Average Payment |
|-----|--|-------------------|---------------|----------------------------|
| 196 | Simple Pneumonia & Pleurisy Without CCMCC | 4.1 | 4.1 | \$3,746.05 |
| 194 | Simple Pneumonia & Pleurisy With CC | 5.3 | 5.0 | \$5,150.18 |
| 193 | Simple Pneumonia & Pleurisy With MCC | 6.7 | 6.6 | \$7,338.37 |

| DRG | TRMC ALOS | Medicare DRG ALOS | TRMC DRG ALOS | * National Average Payment |
|-----|--|-------------------|---------------|----------------------------|
| 179 | Respiratory Infections & Inflammation Without CCMCC | 5.6 | 6.5 | \$5,334.67 |
| 178 | Respiratory Infections & Inflammation with CC | 7.4 | 5.5 | \$7,676.59 |
| 177 | Respiratory Infections & Inflammation with MCC | 9.1 | 9.0 | \$10,448.96 |

2009 = October 1, 2008 – September 30, 2009
 *National Average Payment is calculated with an average hospital Medicare base rate of \$5124.56
 Each hospital's base rate and corresponding payment will vary

Pneumonia

Questions?

Pneumonia

Pneumonia is a leading cause of death. 1909

Pneumonia can be the old person's friend. 1909

Fatal cases of pneumonia often have subtle manifestations. 1887

Pneumonia may be serious in certain groups. 1888

Sir William Osler, MD

The Quotable Osler, M Silverman et al. American College of Physicians 2008

Pneumonia