The essentials of hospital-acquired

Hospital-acquired pneumonia is a growing concern that all nurses need to be aware of. We give you the essentials, from who's most at risk to important nursing interventions and prevention strategies.

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The author has disclosed that she has no significant relationships with or financial interest in any commercial companies that pertain to this educational activity.

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ACCORDING TO THE MOST recent statistics from the CDC, hospital-acquired pneumonia (HAP) accounts for nearly 15% of all hospital-acquired infections (HAIs) and is associated with the highest mortality rates (20% to 33%). It's second only to urinary tract infections as the most common HAI. The American Thoracic Society (ATS) defines HAP as the development of pneumonia, which isn't incubating or present at the time of the patient's admission, more than 48 hours after admission to a health care facility. HAP includes ventilator-associated pneumonia (bacterial pneumonia that develops in patients with acute respiratory failure who've been receiving mechanical ventilation for at least 48 hours), post-op pneumonia, and developing pneumonia in nonventilated and critically ill patients.

In this article, I'll discuss the pathophysiology, risk factors, signs and symptoms, and treatment options for HAP, as well as how to care for a patient who has it and prevent at-risk patients from developing it.

But first, let's quickly review some general information about pneumonia.

Acute inflammation ahead

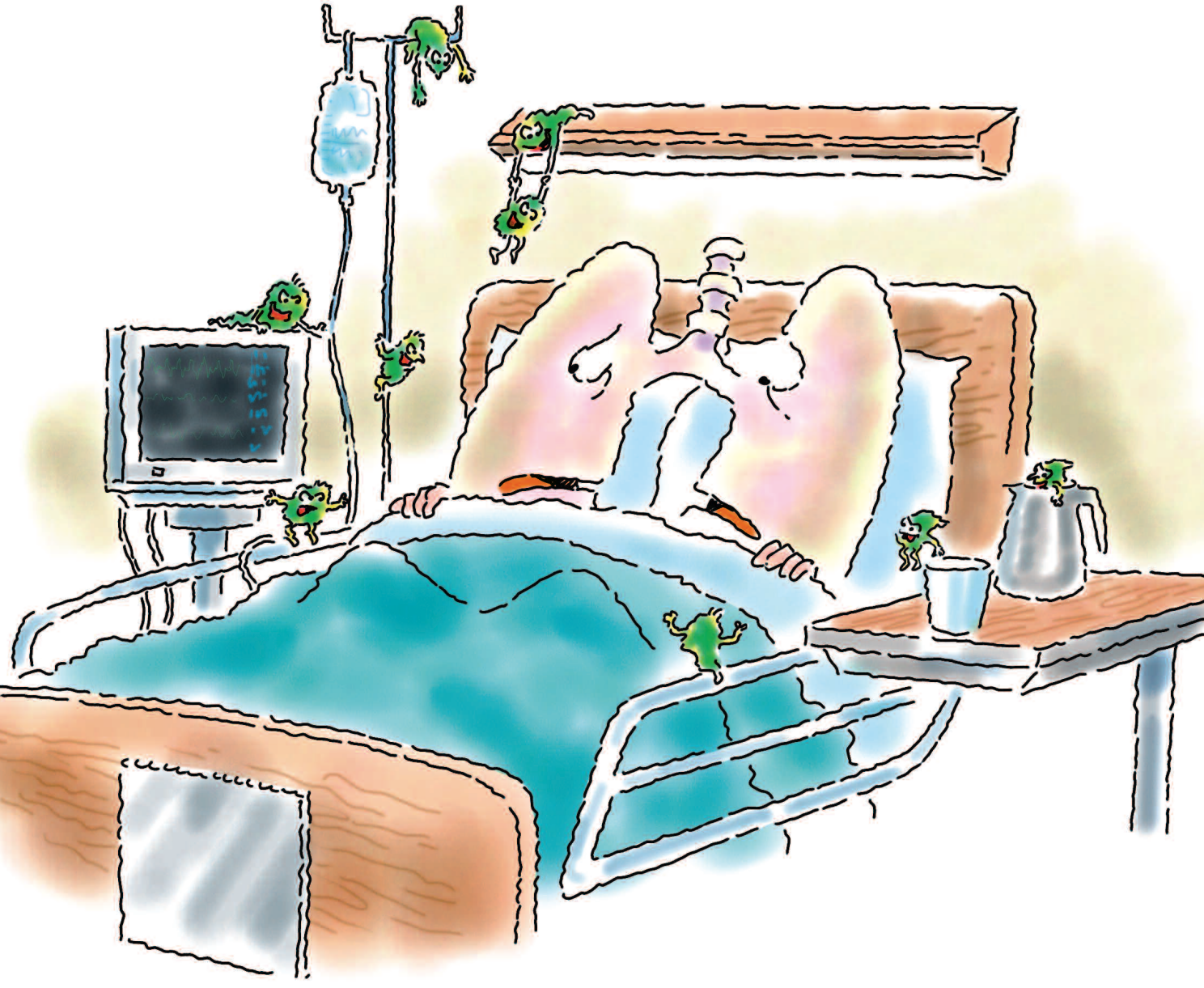
Pneumonia is an acute inflammation of the lungs caused by a bacterial, viral, mycoplasmal, fungal, protozoal, or mycobacterial infection. In bacterial pneumonia, an infection initially triggers alveolar inflammation and edema. In viral pneumonia, a virus attacks bronchiolar epithelial cells, leading to interstitial inflammation and desquamation that spreads to the alveoli. It may be primary, resulting from inhalation of a pathogen, or secondary, resulting from lung damage caused by inhalation of a noxious chemical or other insult or the spread of bacteria from a distant area. Types of pneumonia include:

- ***bronchopneumonia***—involves the distal airways and alveoli
- ***lobular pneumonia***—involves part of the lobe
- ***lobar pneumonia***—involves the entire lobe (see *Picturing pneumonia*).

Besides HAP, pneumonia can be further classified as:

- ***health care–associated pneumonia***—affects patients who aren't hospitalized but who have close contact with the health care

pneumonia



system, such as those who reside in long-term-care facilities or who have regular hemodialysis

• ***community-acquired pneumonia***—occurs in the community setting or within the first 48 hours of admission to a health care facility because of community exposure

• ***aspiration pneumonia***—can occur in the community or health care facility setting and results from inhalation of foreign matter, such as vomitus or food particles, into the bronchi (most common in older patients, patients with a decreased level of consciousness [LOC], and those receiving nasogastric [NG] tube feedings); microaspiration, or aspiration of microbiologic organisms, may also lead to pneumonia in hospitalized patients because they often lack the ability to clear their own airway, allowing colonized bacteria to enter the oropharynx and, subsequently, the lower respiratory tract.

Now, let's delve into HAP specifically.

An unwanted delivery

HAP occurs when at least one of three conditions exist: host defenses are impaired, organisms reach the lower respiratory tract and overwhelm the host's defenses, or a highly virulent organism is present. Certain factors may predispose patients to HAP, such as severe acute or chronic illness, comorbid conditions such as hypotension or metabolic disorders, supine positioning and aspiration, coma, and prolonged hospitalization. Hospitalized patients are also exposed to potential bacteria from other sources, such as respiratory therapy devices and equipment and transmission of pathogens by the hands of health care personnel. Numerous intervention-related factors may play a role in the development of HAP as well, such as therapeutic agents leading to central nervous system depression with decreased ventilation, impaired removal of secretions, or potential aspiration; prolonged or complicated thoracoabdominal procedures; endotracheal (ET) intubation; prolonged or inappropriate use of antibiotics; and use of NG tubes.

The common organisms responsible for HAP include the *Enterobacter* species, *Escherichia coli*, *Haemophilus influenzae*, *Klebsiella pneumoniae*, *Proteus* species, *Serratia marcescens*, *Pseudomonas aeruginosa*, methicillin-sensitive or methicillin-resistant *Staphylococcus aureus,* and *Streptococcus pneumoniae*. Most patients with HAP are colonized with multiple organisms. Pseudomonal pneumonia, which accounts for 15% of HAP cases, occurs in patients who are debilitated, those with altered LOC, and those with prolonged intubation or with tracheostomy. Staphylococcal pneumonia, which accounts for up to 30% of HAP cases, can occur through inhalation of the organism or spread through the hematogenous route (see *Common organisms responsible for HAP*).

Next, let's take a look at which patients are most at risk for HAP, the signs and symptoms to watch for, and the diagnostic tests that may be ordered for your patient.

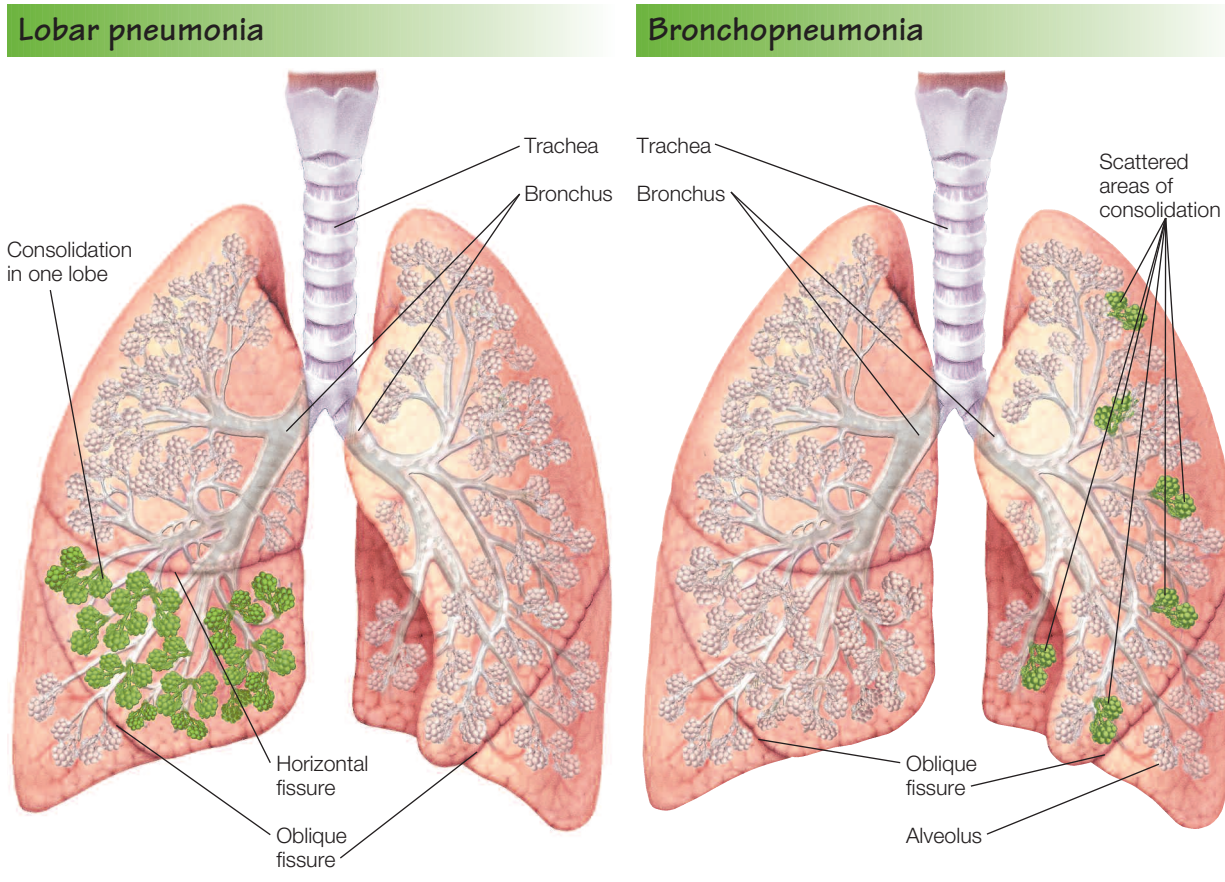
Who's at risk?

Risk factors for HAP include:

• age over 70
• admission to the hospital for burns, trauma, or disease of the central nervous system
• previous thoracic or abdominal surgery
• immunocompromise
• malnutrition
• decreased LOC
• underlying chronic lung disease
• gastric reflux.

Admission or transfer to the ICU increases the risk of HAP primarily due to the likelihood of the patient requiring mechanical ventilation. Mechanically ventilated patients are at greater risk for developing HAP than nonventilated patients: Oropharyngeal secretions may be delivered to

Picturing pneumonia



the lower respiratory tract because the patient is unable to cough on his own due to the artificial airway. If a patient experiences HAP in the ICU, his length of stay in the ICU may be prolonged up to 6 days and in the hospital up to 9 days, with increased costs estimated at $40,000 per patient.

To prevent modifiable risk factors, CDC guidelines include strict infection control, alcohol-based hand disinfection, use of microbiologic surveillance, monitoring and early removal of invasive devices such as ET tubes, and programs to reduce or alter antibiotic prescribing practices.

It's a sign

Signs and symptoms of pneumonia include:

- cough (often dry in older adults due to dehydration; typically productive in younger adults)
- fever higher than 100° F (37.8° C)
- difficulty breathing or dyspnea on exertion (rarely at rest)
- chest pain or discomfort that may be ac-

companied by abdominal pain
• heart rate of more than 100 beats/minute
• rhonchi or crackles on both inspiration and expiration
• overall weakness or fatigue.

Nursing assessment of a patient is critical in detecting pneumonia. Fever, chills, or night sweats in a patient who has respiratory symptoms such as a cough should alert you to the possibility of pneumonia. Further respiratory assessment should include inquiry into pleuritic pain, fatigue, tachypnea, use of accessory muscles for breathing, bradycardia, and purulent sputum. Monitor your patient for changes in

Common organisms responsible for HAP

Organism responsible	Epidemiology	Clinical features	Treatment	Comments
Pseudomonas aeruginosa	• Incidence greatest in those with preexisting lung disease, cancer (particularly leukemia), homograft transplants, or burns; debilitated persons; and patients receiving antimicrobial therapy and treatments such as tracheostomy, suctioning, and in post-op settings • Accounts for 15% of hospital-acquired pneumonia (HAP) cases • Mortality rate: 40% to 60%	• Diffuse consolidation on chest X-ray • Toxic appearance: fever, chills, productive cough, relative bradycardia, and leukocytosis	• Aminoglycoside and antipseudomonal agents (ticarcillin, piperacillin, ceftazidime); other choices include cefepime, imipenem, ciprofloxacin, and colistin	• Complications include lung cavitation • Has capacity to invade blood vessels, causing hemorrhage and lung infarction • Usually requires hospitalization
Staphylococcus aureus	• Incidence greatest in immunocompromised patients, I.V. drug users, and as a complication of epidemic influenza • Accounts for 10% to 30% of HAP cases • Mortality rate: 25% to 60%	• Severe hypoxemia • Cyanosis • Necrotizing infection • Bacteremia is common	• Nafcillin/oxacillin, clindamycin, or linezolid • Methicillin-resistant: vancomycin or linezolid	• Complications include pleural effusion, pneumothorax, lung abscess, empyema, meningitis, and endocarditis • Frequently requires hospitalization • Treatment must be vigorous and prolonged because disease tends to destroy lung tissue
Klebsiella pneumoniae (Friedlander's bacillus-encapsulated Gram-negative aerobic bacillus)	• Incidence greatest in elderly patients, alcoholics, patients with chronic disease (such as diabetes, heart failure, or chronic obstructive pulmonary disease), and patients in chronic care facilities and nursing homes • Accounts for 2% to 5% of community-acquired and 10% to 30% of HAP cases • Mortality rate: 40% to 50%	• Tissue necrosis occurs rapidly • Toxic appearance: fever, cough, sputum production, bronchopneumonia, and lung abscess • Lobar consolidation and bronchopneumonia pattern on chest X-ray	Third- or fourth-generation cephalosporins (cefotaxime, ceftriaxone) plus aminoglycoside, antipseudomonal penicillin, monobactam, or quinolone	• Complications include multiple lung abscesses with cyst formation, empyema, pericarditis, and pleural effusion • May be fulminating, progressing to a fatal outcome

temperature; pulse; amount, odor, and color of respiratory secretions; frequency and severity of cough; degree of tachypnea; and lung auscultation findings.

Your strong assessment skills will come into play when recognizing a change in your patient's respiratory status. For example, an alteration in his breath sounds may lead to a decrease in tolerance for activity and a need for longer rest periods. An increased heart rate or tachycardia may lead to a decrease in oxygenation and a change in his mental status. And use of accessory muscles to breathe may lead to ineffective breathing patterns.

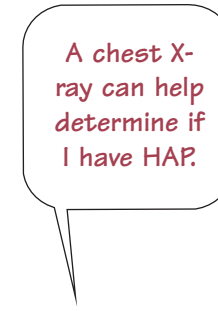
An intubated or critically ill patient will show signs of pneumonia as indicated by his documented respiratory values and Pao_2/FIo_2 levels. Older adults and young children may have symptoms that are nonspecific, such as agitation, confusion, and restlessness, which may make recognizing pneumonia more difficult. As a general rule, if your patient exhibits a fever and cough, pneumonia should be considered.

Likely suspect

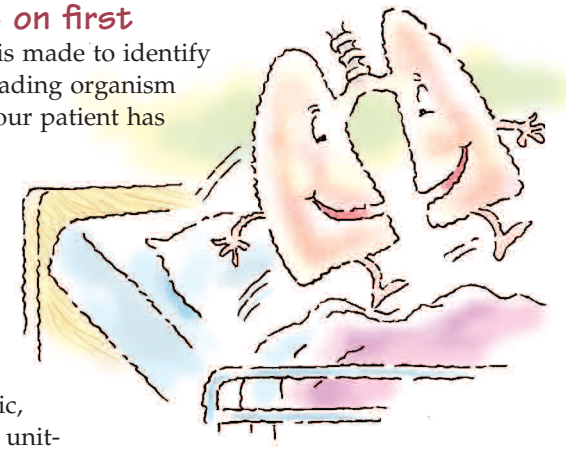
The health care provider will order a chest X-ray to determine areas of consolidation, a white blood cell count with differential to indicate the presence and type of infection and, possibly, an arterial blood gas (ABG) analysis to determine the extent of respiratory compromise due to alveolar inflammation. She may also order bronchoscopy to allow for the collection of sputum cultures to identify the specific infectious organism.

The diagnosis of pneumonia is made on the findings of the chest X-ray, physical exam, sputum specimen collection (in which the patient is instructed to rinse his mouth, deep-breathe, cough, and expectorate into a specimen container; if the patient is already mechanically ventilated, the specimen can be collected via suctioning), and blood cultures. The health care provider will most likely use the Clinical Pulmonary Infection Score, which is based on certain clinical criteria such as the presence of fever and a decrease in blood oxygenation values, to confirm the diagnosis of HAP.

If your patient is diagnosed with HAP, his treatment will depend largely on the organism suspected of causing it. Let's take a closer look.



Antibiotics on first



First, an effort is made to identify the specific invading organism and whether your patient has been infected with an organism that's resistant to multiple drugs. An antibiogram—a document that serves as a facility-specific, and sometimes unit-specific, guide to the prevalence of organisms in your facility and the antibiotics that have been used to effectively treat them—can help. The antibiogram is used as part of an overall assessment of your patient, including time from admission to acquisition of pneumonia, presence of mechanical ventilation, and whether he has recently been treated with antibiotics. If your patient's HAP is caused by a susceptible organism, his treatment will be less complicated.

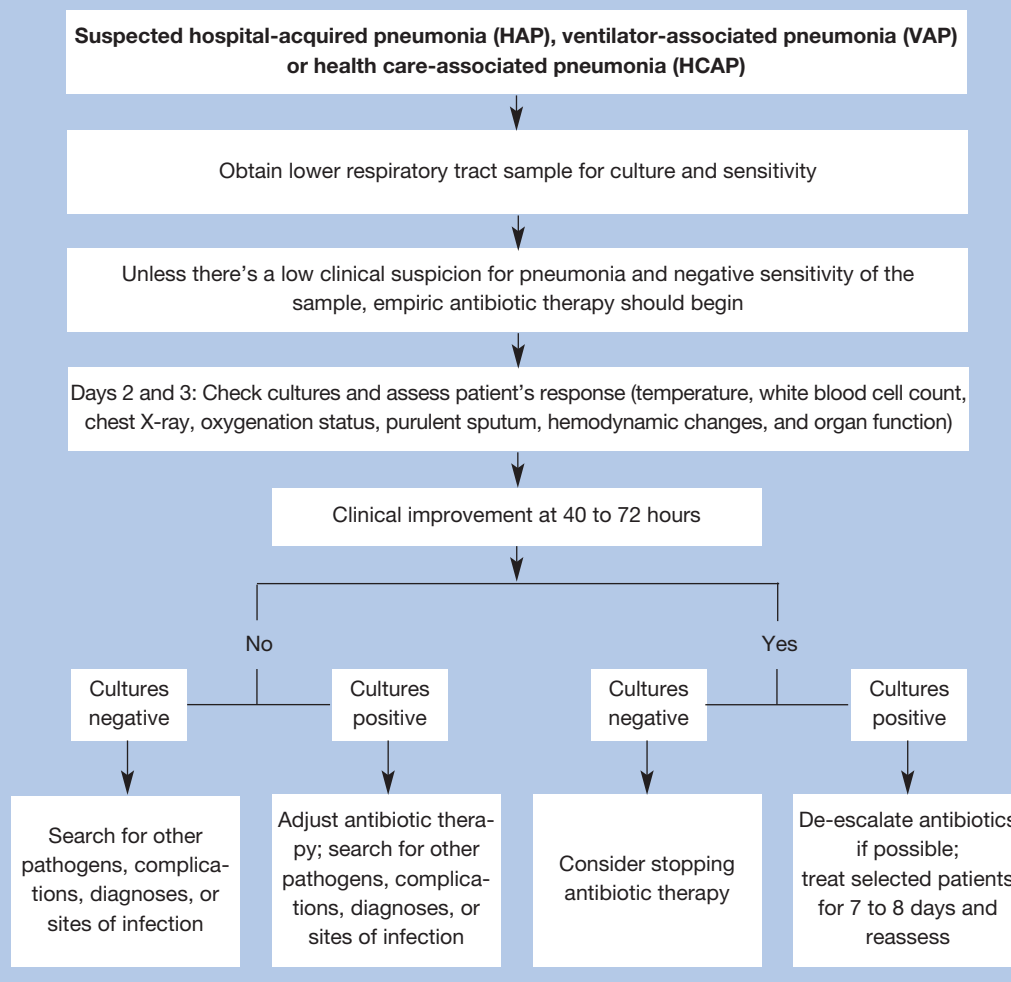
The ATS and the Infectious Diseases Society of America updated their consensus statement on the consistent and evidence-based treatment of HAP in 2005. This treatment guideline emphasizes using antibiotics that are effective against a wider variety of organisms and changing the antibiotic only when the pathogen has been identified. It also states that antibiotic therapy should be as short as possible and last no longer than 8 days because overuse and

inappropriate use of antibiotics can delay the overall response to therapy (see *American Thoracic Society treatment algorithm*).

Antibiotic therapy is usually determined by your facility's antimicrobial pharmacists, infectious diseases specialists, and microbiology department. Treatment may consist of monotherapy or combination therapy, depending on the risk factors involved, the antibiotics' mechanisms of action, and whether an organism has been identified. As mentioned in the treatment guideline, a broad-spectrum antibiotic (such as antipseudomonal cephalosporins, carbapenems, penicillins, fluoroquinolones, and aminoglycosides) should be used early.

The recommended bottom line for antibiotic treatment of HAP is as follows:

American Thoracic Society treatment algorithm



Source: American Thoracic Society. Guidelines for the management of adults with hospital-acquired, ventilator-associated, and healthcare-associated pneumonia, **http://www.thoracic.org/sections/publications/statements/pages/mtpi/guide1-29.html**. Accessed May 20, 2008.

• choose an antibiotic that works against a variety of organisms
• start the antibiotic early and stop it or change it when an organism has been identified
• limit the duration of therapy to 7 to 8 days, depending on the patient's response.

Other treatment measures include:
• supplemental oxygen if the patient is hypoxic (in severe cases, the patient may require mechanical ventilation)
• adequate nutrition and fluid intake
• rest (depending on the severity of the pneumonia; patients may be encouraged to get out of bed to cough and deep-breathe to expectorate secretions and aerate the lungs)
• antitussives for cough may be prescribed
• analgesics as needed to relieve chest pain.

What can you do when caring for a patient with HAP? Let's take a look at nursing interventions next.

Cough, deep-breathe, repeat

Care of a patient who's diagnosed with HAP includes the following:
• Adhere to standard precautions and institute appropriate transmission-based precautions, depending on the causative organism.
• Maintain a patent airway and oxygenation. Reposition your patient to maximize chest expansion and reduce discomfort, and give supplemental oxygen as needed.
• Monitor his oxygen saturation level and ABG values as ordered.
• Assess his respiratory status often, according to your facility's policy. Auscultate his lungs for abnormal breath sounds, such as rhonchi, crackles, or wheezes.
• Encourage coughing and deep breathing.
• Administer antibiotic therapy as ordered.
• Perform meticulous care of his oral cavity to prevent microorganisms from being aspirated and decrease colonization, especially in mechanically ventilated patients.
• If your patient requires tube feedings, administer feedings slowly to prevent aspiration. Keep the head of the bed elevated at least 30 degrees at all times if not contraindicated.

What about patient teaching? That's next on our list.

Anxiety-free teaching

Anxiety related to hospitalization is common, but in a patient with HAP it can lead to compromise of his respiratory functions if not kept in check. If your patient is experiencing anxiety, make sure to help reduce his feelings of anxiousness before attempting to provide education. Explain to him the steps you're taking; for example, when encouraging him to cough and deep-breathe, let him know that it helps clear his airway. If you're performing oral care, tell him it will reduce the bacterial colonization in his mouth. And when raising the head of the bed, explain that it helps prevent aspiration of oral secretions into his lungs.

Patient teaching should include the following:
• Teach your patient and his family about the prescribed antibiotic and any diagnostic tests that are ordered.
• Show him how to cough and perform deep-breathing exercises and encourage him to do so often.
• To prevent pneumonia, advise him to avoid indiscriminate antibiotic use during minor viral infections because this may result in upper airway colonization with antibiotic-resistant bacteria. If he then develops pneumonia, the infecting organisms may require treatment with more toxic antibiotics.
• Encourage high-risk patients, such as those with chronic obstructive pulmonary disease or chronic heart disease, to get an-

Preventive measures for pneumonia

Risk factor	Preventive measure
Conditions that produce mucus or bronchial obstruction and interfere with normal lung drainage (such as cancer, cigarette smoking, or chronic obstructive pulmonary disease)	• Promote coughing and expectoration of secretions • Encourage smoking cessation
Immunosuppressed patients and those with a low neutrophil count (neutropenic)	• Follow standard precautions and screen visitors
Smoking (cigarette smoke disrupts both mucociliary and macrophage activity)	• Encourage smoking cessation
Depressed cough reflex (due to medications, a debilitated state, or weak respiratory muscles); aspiration of foreign material into the lungs during a period of unconsciousness (head injury, anesthesia, or depressed level of consciousness), or abnormal swallowing mechanism	• Reposition frequently to prevent aspiration and administer medications judiciously, particularly those that increase risk of aspiration • Perform suctioning and chest physical therapy if indicated
Nothing-by-mouth status; placement of nasogastric, orogastric, or endotracheal tube	• Promote frequent oral hygiene • Minimize risk of aspiration by checking tube placement and proper positioning of the patient
Supine positioning in patients unable to protect their airway (in very ill people, the oropharynx is likely to be colonized by Gram-negative bacteria)	• Elevate the head of bed at least 30 degrees • Decrease colonization by performing oral care with an antiseptic or antimicrobial agent
Antibiotic therapy	• Monitor patients receiving antibiotic therapy for signs and symptoms of pneumonia • Use antibiotics only when necessary
Alcohol intoxication (because alcohol suppresses the body's reflexes, may be associated with aspiration, and decreases white blood cell mobilization and tracheobronchial ciliary motion)	• Encourage reduced or moderate alcohol intake (in case of alcohol stupor, position the patient to prevent aspiration)
General anesthetic, sedative, or opioid preparations that promote respiratory depression, which cause a shallow breathing pattern and predispose the patient to the pooling of bronchial secretions and potential development of pneumonia	• Observe the respiratory rate and depth during recovery from general anesthesia and before giving medications; if respiratory depression is apparent, withhold the medication and contact the health care provider
Advanced age (because of possible depressed cough and glottic reflexes and nutritional depletion)	• Promote frequent turning, early ambulation and mobilization, effective coughing, breathing exercises, and nutritious diet
Respiratory therapy with improperly cleaned equipment	• Make sure that respiratory equipment is cleaned properly; participate in continuous quality improvement monitoring with the respiratory care department
Transmission of organisms from health care providers	• Use strict hand hygiene along with the use of standard and/or transmission-based precautions • Implement health care provider education regarding stringent infection control practices

Risk factors for HAP

cheat sheet

- Age over 70
- Severe acute or chronic illness
- Comorbid conditions such as hypotension or metabolic disorders
- Malnutrition
- Immunocompromise
- Decreased level of consciousness
- Underlying chronic lung disease
- Gastric reflux
- Coma
- Admission to the hospital for burns, trauma, or disease of the central nervous system
- Prolonged or complicated thoracoabdominal procedures or previous thoracic or abdominal surgery
- Prolonged hospitalization
- Exposure to potential bacteria from respiratory therapy devices and equipment and transmission of pathogens by health care providers' hands
- Administration of therapeutic agents leading to central nervous system depression with decreased ventilation, impaired removal of secretions, or potential aspiration
- Prolonged or inappropriate use of antibiotics
- Supine positioning and aspiration
- Endotracheal intubation
- Use of nasogastric tubes

nual influenza and pneumococcal vaccinations.

- Encourage smoking cessation programs for patients who smoke.

What can you do to prevent HAP?

It's important to remember that a patient who's at risk for pneumonia doesn't have to acquire pneumonia. Because HAP has a high morbidity and mortality rate, efforts should focus on prevention. Preventing HAP is a multilayered process that requires an understanding of risk factors and knowledge of nursing interventions that serve to prevent the development of pneumonia and promote patient safety. As you care for the patient at risk, you can identify areas that may predispose him to HAP and work to prevent it (see *Preventive measures for pneumonia*).

Here are some prevention tips you can use.

- Follow the CDC's guidelines for hand hygiene and overall infection control.
- Elevate the head of the bed between 30 and 45 degrees, if not contraindicated, to help prevent aspiration.
- Verify feeding tube placement regularly and check residual volumes to prevent distension that may result in aspiration.
- Perform or assist your patient with oral care to reduce the number of organisms in his mouth.
- Know and follow your facility's policy for replacing suctioning catheters or other items that may be used in his mouth.
- Encourage deep breathing and assist with ambulation, if not contraindicated, so he's better able to maintain a clear airway.
- If your patient is post-op, utilize incentive spirometry, as indicated, to maximize his ventilatory volume and promote coughing to clear the airway.
- Ensure your patient receives his antibiotics as scheduled.

Got the essentials covered

Knowing the essentials of HAP will not only help you care for a patient who has

already been diagnosed with it, but also help you prevent other patients from developing it. Now that's essentially good news! ■

Learn more about it

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The essentials of hospital-acquired pneumonia

GENERAL PURPOSE: To provide the professional nurse with an overview of hospital-acquired pneumonia (HAP). **LEARNING OBJECTIVES:** After reading this article and taking the test, you should be able to: 1. Discuss the incidence and pathophysiology of HAP. 2. Describe the risk factors and signs and symptoms of HAP. 3. Explain the treatment and prevention strategies for HAP.

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1. Which statistic about HAP is correct?
a. HAP accounts for 30% of all hospital-acquired infections (HAIs).
b. HAP has the highest mortality rate of all HAIs.
c. HAP is the most common HAI.

2. Which type of pneumonia involves the distal airways and the alveoli?
a. lobular pneumonia
b. lobar pneumonia
c. bronchopneumonia

3. Staphylococcal pneumonia accounts for up to
a. 30% of HAP cases.
b. 45% of HAP cases.
c. 50% of HAP cases.

4. Which of the following is a risk factor for HAP?
a. age older than 60
b. hospital admission for heart failure
c. gastric reflux

5. Which statement about length of stay (LOS) related to HAP is correct?
a. LOS in the ICU may be prolonged up to 6 days.
b. LOS in the ICU isn't generally affected.
c. LOS in the hospital is often prolonged by 2 weeks or more.

6. Clinical signs of pneumonia include
a. persistent dyspnea at rest.
b. temperature of 100º F (37.8º C).
c. rhonchi or crackles on both inspiration and expiration.

7. Which assessment finding may indicate a worsening in the patient's respiratory status?
a. decreased heart rate
b. decreased activity tolerance
c. decreased use of accessory muscles

8. Treatment for HAP will largely depend on the
a. Clinical Pulmonary Infection Score.
b. organism suspected of causing it.
c. chest X-ray results.

9. An antibiogram includes all of the following *except*
a. recent antibiotic treatments.
b. time from admission to acquisition of pneumonia.
c. time to first dose of antibiotics.

10. According to current guidelines, which statement about antibiotic therapy is correct?
a. Initial antibiotic therapy should be organism specific.
b. Antibiotic therapy should be ordered for 7 to 14 days.
c. Antibiotic therapy should last no longer than 8 days.

11. Which type of antibiotic should be started early?
a. tetracycline
b. vancomycin
c. broad-spectrum antibiotic

12. Which therapy is needed by all patients with HAP?
a. adequate nutrition and fluid intake
b. supplemental oxygen
c. analgesics

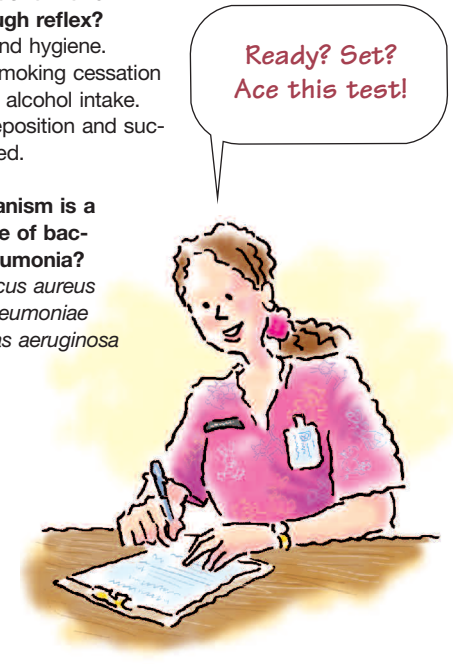
13. Which of the following is an effective prevention strategy for HAP?
a. Elevate the head bed between 60 and 90 degrees for all at-risk patients.
b. Perform or assist with appropriate oral hygiene.
c. Use only parenteral nutrition for high-risk patients.

14. The American Thoracic Society guidelines recommend checking the patient's response to therapy after 2 or 3 days using
a. the patient's temperature.
b. arterial blood gas values.
c. a computed tomography scan.

15. Diagnostic cultures should be obtained from the
a. nares.
b. upper respiratory tract.
c. lower respiratory tract.

16. Which preventive measures are geared specifically toward the patient with a depressed cough reflex?
a. Use strict hand hygiene.
b. Encourage smoking cessation and reduced alcohol intake.
c. Frequently reposition and suction as needed.

17. Which organism is a common cause of bacteremia in pneumonia?
a. *Staphylococcus aureus*
b. *Klebsiella pneumoniae*
c. *Pseudomonas aeruginosa*



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