

**Table 9.1**  
**Common Causes of Fever in Intensive Care Unit Patients**

---

- Pneumonia
  - In-dwelling catheters
  - Pressure sores
  - *Clostridium difficile* colitis
  - Sinusitis (in patients with a nasogastric tube)
  - Acalculous cholecystitis
  - Pancreatitis
  - Venous thromboembolism
  - Drug fever (refer to Table 4.12)
- 

**Table 9.2**  
**Prevention of Hospital-Acquired and Ventilator-Associated Pneumonia**

---

*Nonpharmacological*

- Avoid tracheal intubation if possible
- Avoid nasal intubation
- Removal of nasogastric and endotracheal tubes when appropriate
- Shorten duration of mechanical ventilation
- Avoid gastric overdistention (<150 mL)
- Subglottic suctioning (questionable efficacy)
- Drain ventilator circuit condensate

From: *Pocket Guide to Critical Care Pharmacotherapy*  
By: J. Papadopoulos © Humana Press Inc., Totowa, NJ

- Use of heat and moisture exchangers
- Avoid unnecessary ventilator circuit changes/manipulation
  - Unless visually contaminated with blood, emesis, or purulent secretions
- Semirecumbent positioning (between 30 and 45°, even during patient transport)
- Maintain appropriate endotracheal cuff pressure
- Formal infection control program
- Appropriate hand washing and/or use of ethanol-based hand sanitizers
  - Note that the ethanol-based hand sanitizers are not sporicidal

### *Pharmacological*

- Avoid unnecessary antimicrobials
- Short-course antimicrobials
- Avoid unnecessary stress to ulcer prophylaxis that alters gastric pH
  - Sucralfate does not alter gastric pH
- Vaccinations in the appropriate patients
  - *Streptococcus pneumoniae*, *Haemophilus influenzae*, and influenza virus
- Avoid unnecessary red blood cell transfusions

---

*Crit. Care Med.* 2004;32:1396–1405.

### **Table 9.3** **Management of Hospital-Acquired and Ventilator-Associated Pneumonia**

---

- Obtain appropriate cultures and sensitivities
- Calculate clinical pulmonary infection score (refer to Table 9.4)
- Early invasive diagnosis of ventilator-associated pneumonia (VAP) utilizing either broncho-alveolar lavage or protected specimen brush techniques may improve outcome by facilitating identification of a causative pathogen or facilitating diagnosis of extrapulmonary infections
- Initiate early, aggressive, and empiric intravenous therapy

- Target all likely organisms
  - Must know common prevalent organisms and resistance patterns in your institution and intensive care unit
- Early-onset hospital-acquired pneumonia
  - Occurring 2–4 d after acute care hospital admission
  - Commonly associated with antibiotic-sensitive bacteria
  - *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *oxacillin-sensitive Staphylococcus aureus*
    - Unless risk factors for infection owing to potentially antibiotic-resistant bacteria
- Late-onset hospital-acquired pneumonia
  - Occurring  $\geq 5$  d after acute care hospital admission
  - Usually antibiotic-resistant bacteria
  - Oxacillin-resistant *S. aureus*, *Pseudomonas aeruginosa*, *Acinetobacter* spp., *Enterobacter* spp., and *Klebsiella pneumoniae*
- Ventilator-associated pneumonia
  - Nosocomial bacterial pneumonia developing in patients on mechanical ventilation
  - *Early-onset* (within 48–72 h after mechanical intubation)
    - Antibiotic-sensitive bacteria
    - Unless risk factors for infection owing to potentially antibiotic-resistant bacteria
  - *Late-onset* (>72 h after mechanical intubation)
    - Antibiotic-resistant bacteria
    - Oxacillin-resistant *S. aureus*, *P. aeruginosa*, *Acinetobacter* sp., *Enterobacter* sp., and *K. pneumoniae*
- Antimicrobial pharmacotherapy (combination therapy)
  - Oxacillin-resistant *S. aureus* coverage
    - Vancomycin
      - Target trough levels between 15 and 20 mcg/mL (to increase pulmonary penetration)
    - Linezolid
      - In patients who have received a recent course of vancomycin and/or are critically ill (based on a high APACHE II score)
  - Broad Gram-negative coverage including *P. aeruginosa*

- Recommend initial combination therapy to increase probability of having at least one drug that covers the likely pathogen (personal opinion)
- Piperacillin-tazobactam, cefepime, imipenem, or meropenem *plus either*:
  - An aminoglycoside (consider high-concentration [once-a-day] dosing in patients with a creatinine clearance above 30 mL/min) *or*
  - Ciprofloxacin (400 mg IV q8h and adjust for creatinine clearance) or levofloxacin (750 mg IV qd and adjust for creatinine clearance)
- Stream-line antimicrobial therapy based on clinical judgment, patient response, and microbiological data
- Consider short-course therapy (8 d) based on clinical judgment and patient response
  - May not apply to pneumonias caused by *P. aeruginosa* or *Acinetobacter* spp.

*Am. J. Resp. Crit. Care Med.* 2005;171:388–416.

*Drugs* 2003;63(20):2157–2168.

*Chest* 2002;122:2183–2196.

*JAMA* 2003;290:2588–2598.

### **Table 9.4** **Clinical Pulmonary Infection Score (CPIS) Calculation**

#### *Temperature (°C)*

- 36.5 – 38.4 = 0 points
- 38.5 – 38.9 = 1 point
- >39 or <36 = 2 points

#### *Blood leukocyte count (mm<sup>3</sup>)*

- 4000 – 11,000 = 0 points
- <4000 or >11,000 = 1 point
- Bands >50%, add 1 additional point

*Tracheal secretions*

- Absent = 0 points
- Nonpurulent = 1 point
- Purulent = 2 points

*Oxygenation ( $PaO_2/FIO_2$  in mmHg)*

- $>240$  = 0 points
- Presence of ARDS = 0 points
- $\leq 240$  = 2 points

*Pulmonary radiography*

- No infiltrate = 0 points
- Diffuse or patchy infiltrate = 1 point
- Localized infiltrate = 2 points

*Progression of pulmonary infiltrate*

- No progression = 0 points
- Radiographic progression = 2 points
  - Exclude ARDS and pulmonary edema

*Tracheal aspirate cultures (semiquantitative analysis of pathogenic bacteria)*

- No growth, rare or light quantity = 0 points
- Moderate or heavy quantity = 1 point
- Same pathogenic bacteria seen on Gram-stain, add 1 additional point

---

*Am. J. Resp. Crit. Care Med.* 2000;162:505–511.

*Am. Rev. Resp. Dis.* 1991;143:1121–1129.

*Note:*

- (a) CPIS score  $>6$  is the threshold for suspected pneumonia.
- (b) At baseline, assess the first five variable, and
- (c) At 72 h, assess all seven variables.