## Antimicrobial Treatment of Ventilator-Associated Pneumonia (VAP)

(New Brunswick Provincial Health Authorities Anti-Infective Stewardship Committee, September 2019)

**Definition:** Pneumonia that develops 48 hours or more after endotracheal intubation.

**Probable pathogens:** S. aureus (MRSA or MSSA), Gram-negative bacilli (e.g., *E. coli, K. pneumoniae, P. aeruginosa, A. baumannii*).

**Microbiological analyses (always order):** Blood cultures x 2 sets + endotracheal suctioning for culture

### Risk stratification

<table>
<thead>
<tr>
<th>If NO risk factor</th>
<th>Patient's Condition</th>
<th>Empiric therapy*</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>(indicated below)</td>
<td>Stable</td>
<td>First-line</td>
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<tr>
<td></td>
<td></td>
<td>cefTRIAZone 2 g IV q24h</td>
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<td>If true immediate allergy to a beta-lactam at risk for cross-reactivity with cefTRIAZone*: or severe delayed reaction to a beta-lactam: levoFLOXacin 750 mg IV q24h*</td>
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### Risk factors for multidrug resistant (MDR) pathogens or poor outcomes

- Septic shock
- Use of IV antibiotics in past 90 days
- Immunosuppression
- Chronic lung disease (e.g., bronchiectasis, cystic fibrosis)
- Acute renal replacement therapy before VAP onset
- Hospitalization for at least 5 days before VAP onset
- Acute respiratory distress syndrome (ARDS) before VAP onset

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<td>(requiring a higher intensity of care or support but not septic shock; i.e. sepsis, increased ventilatory support, etc.)</td>
<td>piperacillin-tazobactam 4.5 g IV q6h*</td>
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### Duration of therapy

- **Treat for no more than 7 days if good clinical response, regardless of bacterial etiology.**
- **Treatment duration could be prolonged for more than 7 days in certain situations (e.g., empyema, extrapulmonary infections, *S. aureus* bacteremia, immunosuppression, etc.)**

### Empiric therapy

- **First-line**
  - cefTRIAZone 2 g IV q24h
  - If true immediate allergy to a beta-lactam at risk for cross-reactivity with cefTRIAZone*: or severe delayed reaction to a beta-lactam: levoFLOXacin 750 mg IV q24h*

- **Second anti-pseudomonal agent** should be from another class, and can include:
  - tobramycin 7 mg/kg IV q24h* OR
  - ciprofloxacin 400 mg IV q8h*.

- Tailor antibiotic therapy based on microbiology results.

### Associated conditions

- **Unstable**
  - Septic shock requiring vasopressors, or with a risk factor for MRSA:
    - History of MRSA infection or colonization
    - Household contact with a MRSA colonized individual
    - Injection drug use
    - Homelessness
    - Incarcerated person
    - Recent travel to or residing in a MRSA endemic region or community

- **If history of infection or colonization with Gram-negative bacilli producing AmpC or ESBL beta-lactamases, empiric use of meropenem is encouraged (may consider fluoroquinolones if susceptibility known, stable and no risk factors).**

- **DO NOT use cefTRIAZone if *Pseudomonas* infection is confirmed or suspected.**

- If the patient received an antibiotic in the past 3 months, choose an antibiotic from a different class, regardless of clinical success.

- **Second anti-pseudomonal agents** should be from another class, and can include:
  - tobramycin 7 mg/kg IV q24h* OR
  - ciprofloxacin 400 mg IV q8h*
Clinical Pearls

- Recent studies have shown that, compared with standard treatment durations of 10 days or more, 7-day treatment durations were associated with fewer relapses caused by multiresistant pathogens WITHOUT affecting mortality rate.
- To avoid prolonged use of broad-spectrum antibiotics, it is essential to de-escalate therapy according to the results of microbiologic analyses.
- The role of antimicrobials in the treatment of ventilator-associated tracheobronchitis is controversial. Consider initiating antimicrobial therapy if clinical deterioration (e.g. progressive hypoxemia).
- Empiric double coverage of Pseudomonas aeruginosa is to maximize the likelihood of having at least one active agent (due to increased risk of resistance with Pseudomonas). If Pseudomonas is isolated, step-down to monotherapy (according to susceptibility data). ***Use of aminoglycosides (e.g., tobramycin and gentamicin) as monotherapy for the treatment of pneumonia is NOT recommended (even if susceptibility is confirmed).
- DO NOT use DAPTOmycin to treat pneumonia; DAPTOmycin is inactivated by pulmonary surfactant. If MRSA infection, use vancomycin (or linezolid if vancomycin is ineffective or inappropriate).
- Serial procalcitonin levels (if available), in combination with clinical evaluation, may assist in the decision to discontinue antibiotics.

* Dose adjustment required in renal impairment.
∞ If microbial cause of infection known, treat accordingly.
▲ Immediate, IgE mediated allergies include, but are not limited to, anaphylaxis, urticaria, angioedema, hypotension, bronchospasm, stridor, and pruritic rash.
‡ Severe delayed hypersensitivity reactions to beta-lactams are caused by mechanisms that are not well known and require that subsequent use of beta-lactams be avoided. Severe delayed hypersensitivity reactions can include interstitial nephritis, immune hepatitis, hemolytic anemia, serum sickness, severe cutaneous reactions such as Stevens-Johnson syndrome, toxic epidermal necrolysis, and drug rash with eosinophilia and systemic symptoms (DRESS).
¶ Ventilator-associated tracheobronchitis: fever with no other identifiable cause with: significant purulent secretions, positive endotracheal aspirate culture, and ABSENCE of pneumonia on a chest X-ray.

References:

5. Management of Penicillin and Beta-Lactam Allergy. NB-ASC. 02-2016
6. Adult Antimicrobial Dosing Tool. NB-ASC. 11-2015