Hospitalized patient with an artificial airway (intubated or with a tracheostomy)

Does patient have 2 or more of the symptoms below?
- Cough
- Fever or hypothermia
- New or increased sputum production
- Rhonchi and/or wheezing

Yes
- Obtain a chest x-ray
- Manage respiratory support as appropriate for findings

No
- Tracheobronchitis Definition
- Infants ≥ 1 month up to adults
- Infants ≥ 3 months up to adults
- Infants >1 mo
- Infants ≥ 3 months up to adults

Min BAL culture* or tracheal aspirate culture

Yes
- Treat for bacterial pneumonia
- Manage as appropriate for symptoms

No
- Mini BAL culture positive threshold
- Max BAL culture positive threshold

Respiratory viral panel and tracheal aspirate culture

Yes
- Viral pneumonia or viral tracheobronchitis? (Positive respiratory viral panel)
- Supportive therapy
- Directed antiviral therapy

No
- Tracheal aspirate culture positive?

Yes
- Consider short course (5 - 7 days) of antibiotics* (if not already given)
- Manage as appropriate for symptoms

No
- Tracheal aspirate culture negative?

Consider short course (5 - 7 days) of antibiotics* (if not already given)
- Manage as appropriate for symptoms

Exclusion Criteria
- New tracheostomy or intubation within the past 48 hours
- No clinical or radiographic evidence of pneumonia
- A positive culture* obtained by deep tracheal aspirate or bronchoscopy
- Any 2 of the following signs or symptoms with no other recognized cause:
  - Fever or hypothermia
  - Cough
  - New or increased sputum production
  - Rhonchi and/or wheezing
  - Worsening oxygenation or increased ventilator support

Culture Positive Thresholds
- Tracheal aspirate culture positive threshold – moderate to abundant growth
- Max BAL culture positive threshold - >10^5 CFU/mL

Antibiotic Course Duration
- Antibiotic course can likely be shortened to 5 days with rapid clinical improvement
- There is rarely a need to extend the course to 10 days for certain patients

Amoxicillin
- PO infants ≥ 3 months up to adults: 50 mg/kg/dose every 8 h; MAX 2,000 mg/dose
- PO infants ≥ 3 months up to adults: 50 mg/kg/dose every 8 h; MAX 2,000 mg of amoxicillin/dose
- PO infants ≥ 3 months up to adults: < 40 kg: Augmentin ES 600-42.9mg/5mL suspension (Augmentin ES-600) 3-40 kg: Augmentin XR 1000-62.5mg tab (cannot crush) OR Augmentin ES 600-42.9mg/5mL suspension (Augmentin ES-600)

Cefadroxil
- PO infants ≥ 3 months up to adults: 50 mg/kg/dose every 8 h; MAX 2,000 mg/dose
- PO infants ≥ 3 months up to adults: 50 mg/kg/dose every 8 h; MAX 2,000 mg of cefadroxil/dose

Cefpodoxime
- PO infants ≥ 1 month up to adults: 20 mg/kg/dose every 8 h; MAX 900 mg/dose

Vancocin
- PO infants ≥ 1 month up to adults: 15 mg/kg/dose every 8 h; MAX 1,500 mg/dose OR 4,000 mg/DAY

Known colonization of organisms susceptible to amoxicillin/clavulanate or mixed flora, *Known colonization of gram negative organisms resistant to ceftriaxone, †Known colonization with gram negative organisms susceptible to ceftriaxone, ^Known colonization of gram negative organisms resistant to ceftriaxone, ‡Known colonization of Staphylococcus spp.

Clinical standards are developed for 80% of the patient population with a particular disease. Each practitioner must use his/her clinical judgment in the management of any specific patient.
Patient with a tracheostomy

Does patient have 2 or more of the symptoms below?

- Fever or hypothermia
- New or increased sputum production
- Rhonchi and/or wheezing
- Cough

Yes

Off Algorithm
Manage symptoms as appropriate

No

Obtain tracheal aspirate culture
Consider a chest x ray if diagnosis is unclear
Manage respiratory support as appropriate for findings

Does chest x ray or exam findings show evidence of bacterial pneumonia?

Yes

Treat for bacterial pneumonia

No

Obtain tracheal aspirate culture
Consider respiratory viral panel (PCR recommended by pathology)

Does chest x ray or exam findings show evidence of bacterial pneumonia?

Yes

Consider obtaining a respiratory viral panel

No

Viral pneumonia or viral tracheobronchitis? (Positive respiratory viral panel)

Yes

Supportive therapy
Directed antiviral therapy

Tracheal aspirate culture positive?

Yes

Consider short [5-7 days] course of antibiotics

Supportive care
Directed antiviral therapy if not already given

No

Patient meets criteria for bacterial tracheobronchitis = Consider short term (5-7 days) antibiotics

Tracheal aspirate culture positive?

Yes

Manage as appropriate for findings

Off Algorithm

No

Additionally, the image contains a table for "Outpatient Empiric and Directed Antibiotic Therapy for Suspected Tracheobronchitis" with details on drug names, routes, dosages, and frequencies. The table includes indications such as age and weight parameters, and notes on antibiotic course duration.

(Choose empiric antibiotic based on previous organism grown within 6 months; Narrow based on known susceptibilities)

- Aminocillin
- Aminocillin/clavulanate
- Ceftriaxone
- Cefuroxime
- Ceftazidime
- Cefuroxime
- Levofloxacin

- Aminocillin
- Aminocillin/clavulanate
- Ceftriaxone
- Cefuroxime
- Ceftazidime
- Cefuroxime
- Levofloxacin

- Aminocillin
- Aminocillin/clavulanate
- Ceftriaxone
- Cefuroxime
- Ceftazidime
- Cefuroxime
- Levofloxacin

- Aminocillin
- Aminocillin/clavulanate
- Ceftriaxone
- Cefuroxime
- Ceftazidime
- Cefuroxime
- Levofloxacin

- Aminocillin
- Aminocillin/clavulanate
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- Cefuroxime
- Levofloxacin

- Aminocillin
- Aminocillin/clavulanate
- Ceftriaxone
- Cefuroxime
- Ceftazidime
- Cefuroxime
- Levofloxacin

Clinical standards are developed for 80% of the patient population with a particular disease. Each practitioner must use his/her clinical judgment in the management of any specific patient.
Critical Points of Evidence

Evidence Supports

- Tracheobronchitis should be diagnosed based upon the criteria below. – Strong recommendation, low quality evidence (1,2)
  - No clinical or radiographic evidence of pneumonia
  - A positive culture obtained by deep tracheal aspirate or bronchoscopy
  - ≥2 of the following signs or symptoms with no other recognized cause:
    - Fever or hypothermia
    - Cough
    - New or increased sputum production
    - Rhonchi and/or wheezing
    - Worsening oxygenation or increased ventilator support

- Consider the use a short course (5 - 7 days) of systemic antibiotics for the treatment of tracheobronchitis. – Weak recommendation, low quality evidence (1,3-5)

- Inhaled antibiotics should not be used for inpatient treatment of tracheobronchitis. – Strong recommendation, low quality evidence (6-11)

  Remarks – Chronic inhaled antibiotics may be utilized in the outpatient population to decrease bacteria load and prevent acute illness.

- Viral testing should be utilized for patients with suspected tracheobronchitis. – Strong recommendation, very low quality evidence (1,12-14)

- Diagnostic testing for tracheobronchitis should be initiated in patients with ≥2 of the following symptoms. – Strong recommendation, low quality evidence (1,2,14,15)
  - Fever or hypothermia
  - Cough
  - New or increased sputum production
  - Rhonchi and/or wheezing
  - Worsening oxygenation or increased ventilator support

*NOTE: The references cited represent the entire body of evidence reviewed to make each recommendation.

Measures

Process

- Length of stay (LOS)
- Use of viral testing when prevalence of virus in the community is low
- Number of tracheal aspirate cultures with contaminants
- Number of patients returning to the EC for repeat blood cultures
- Use of inhaled antibiotic therapy
- Parenteral antibiotic use
- Usefulness of past tracheal aspirates to aid in diagnosis/disposition of patient

Outcome

- Incidence of tracheobronchitis
- Incidence of pneumonia
- Incidence of patients admitted with a misdiagnosis of tracheobronchitis
## Empiric Antibiotic Therapy

(Choose empiric antibiotic based on previous organism grown within 6 months; Narrow based on known susceptibilities)

<table>
<thead>
<tr>
<th>Drug</th>
<th>Route</th>
<th>Age and Weight Parameters</th>
<th>Dose and Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin</td>
<td>PO</td>
<td>Infants ≥ 3 months up to adults</td>
<td>45 mg/kg/dose every 12 h; MAX 2,000 mg/dose</td>
</tr>
<tr>
<td>Amoxicillin/clavulanate#</td>
<td>PO</td>
<td>Infants ≥ 3 months up to adults</td>
<td>45 mg/kg/dose every 12 h; MAX 2,000 mg of amoxicillin/dose</td>
</tr>
<tr>
<td>Ceftazidime*</td>
<td>IV</td>
<td>Infants ≥ 1 month up to adults</td>
<td>50 mg/kg/dose every 8 h; MAX 2,000 mg/dose</td>
</tr>
<tr>
<td>Ceftriaxone‡</td>
<td>IV</td>
<td>Infants ≥ 1 month up to adults</td>
<td>50 mg/kg/dose every 24 h; MAX 2,000 mg/dose</td>
</tr>
<tr>
<td>Ceftazidime*</td>
<td>IV</td>
<td>Infants ≥ 1 month up to adults</td>
<td>50 mg/kg/dose every 8 h; MAX 2,000 mg/dose</td>
</tr>
<tr>
<td>Cefepime^</td>
<td>PO</td>
<td>Infants ≥ 3 months up to adults</td>
<td>10 mg/kg/dose every 12 h; MAX 600 mg/dose</td>
</tr>
<tr>
<td>Clindamycin†</td>
<td>IV</td>
<td>Infants ≥ 1 month up to adults</td>
<td>10 mg/kg/dose every 8 h; MAX 900 mg/dose</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>IV</td>
<td>Infants &gt;1 month up to adults</td>
<td>15 mg/kg/dose every 8 h; MAX 1,500 mg/dose OR 4,000 mg/DAY</td>
</tr>
</tbody>
</table>

#Known colonization of organisms susceptible to amoxicillin/clavulanate or mixed flora; *Known colonization of gram negative organisms resistant to ceftriaxone; ‡Known colonization with gram negative organisms susceptible to ceftriaxone; ^Known colonization of gram negative organisms resistant to ceftazidime; †Known colonization of Staphylococcus spp.

## OUTPATIENT Empiric and Directed Antibiotic Therapy for Suspected Tracheobronchitis

(Choose empiric antibiotic based on previous organism grown within 6 months; Narrow based on known susceptibilities)

<table>
<thead>
<tr>
<th>Drug</th>
<th>Route</th>
<th>Age and Weight Parameters</th>
<th>Dose and Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amoxicillin</td>
<td>PO</td>
<td>Infants ≥ 3 months up to adults</td>
<td>45 mg/kg/dose every 12 h; MAX 2,000 mg/dose</td>
</tr>
<tr>
<td>Amoxicillin/clavulanate#</td>
<td>PO</td>
<td>Infants ≥ 3 months up to adults</td>
<td>45 mg/kg/dose every 12 h; MAX 2,000 mg of amoxicillin/dose</td>
</tr>
<tr>
<td>Cefdinir</td>
<td>PO</td>
<td>Infants ≥ 6 months up to adults</td>
<td>7 mg/kg/dose every 12 h; MAX 300 mg/dose</td>
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<tr>
<td>Cefixime*</td>
<td>PO</td>
<td>Infants ≥ 6 months up to adults</td>
<td>4 mg/kg/dose every 12 h; MAX 200 mg/dose</td>
</tr>
<tr>
<td>Clindamycin†</td>
<td>PO</td>
<td>Infants ≥ 1 month &amp; children</td>
<td>10 mg/kg/dose every 8 h; MAX 600 mg/dose</td>
</tr>
<tr>
<td>Adults</td>
<td></td>
<td></td>
<td>600 mg/dose every 8 h; MAX 600 mg/dose</td>
</tr>
<tr>
<td>Ciprofloxacin‡</td>
<td>PO</td>
<td>Infants ≥ 3 months up to adults</td>
<td>10 mg/kg/dose every 12 h; MAX 500 mg/dose</td>
</tr>
<tr>
<td>Levofloxacin^</td>
<td>PO</td>
<td>Infants ≥ 6 months &amp; children &lt; 5 years</td>
<td>10 mg/kg/dose every 12 hours; MAX 500 mg/dose</td>
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<tr>
<td>Children ≥ 5 years &amp; adults</td>
<td></td>
<td></td>
<td>10 mg/kg/dose every 24 hours; MAX 750 mg/dose</td>
</tr>
</tbody>
</table>

#Known colonization of organisms susceptible to amoxicillin/clavulanate or mixed flora; *For patients with non-public insurance; †Known colonization of Staphylococcus spp.; ^Alternative agent for ciprofloxacin for patients with enteral tube or for oral beta-lactams for patients with beta-lactam allergy.
References


Clinical Standards Preparation

This clinical standard was prepared by the Evidence-Based Outcomes Center (EBOC) team in collaboration with content experts at Texas Children's Hospital. Development of this clinical standard supports the TCH Quality and Patient Safety Program initiative to promote clinical standards and outcomes that build a culture of quality and safety within the organization.

Management of Respiratory Symptoms and Possible Infectious Complications in Patients With an Artificial Airway

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Evaluation of the Quality of the Evidence

Published clinical guidelines were evaluated for this review using the AGREE II criteria. The summary of these guidelines are included in the literature appraisal. AGREE II criteria evaluate Guideline Scope and Purpose, Stakeholder Involvement, Rigor of Development, Clarity and Presentation, Applicability, and Editorial Independence using a 4-point Likert scale. The higher the score, the more comprehensive the guideline.

This clinical standard specifically summarizes the evidence in support of or against specific interventions and identifies where evidence is lacking/inconclusive. The following categories describe how research findings provide support for treatment interventions.

**Evidence Supports** provides evidence to support an intervention
**Evidence Against** provides evidence against an intervention.
**Evidence Lacking/Inconclusive** indicates there is insufficient evidence to support or refute an intervention and no conclusion can be drawn from the evidence.

The GRADE criteria were utilized to evaluate the body of evidence used to make practice recommendations. The table below defines how the quality of the evidence is rated and how a strong versus weak recommendation is established. The literature appraisal reflects the critical points of evidence.

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Quality</th>
<th>Type of Evidence</th>
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<tr>
<td>STRONG</td>
<td>Desirable effects clearly outweigh undesirable effects</td>
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</tr>
<tr>
<td>WEAK</td>
<td>Desirable effects closely balanced with undesirable effects</td>
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</tbody>
</table>

**Recommendations**

Practice recommendations were directed by the existing evidence and consensus amongst the content experts. Patient and family preferences were included when possible. The Content Expert Team and EBOC team remain aware of the controversies in the management of respiratory symptoms and possible infectious complications in patients with an artificial airway. When evidence is lacking, options in care are provided in the clinical standard and the accompanying order sets (if applicable).

**Approval Process**

Clinical standards are reviewed and approved by hospital committees as deemed appropriate for its intended use. Clinical standards are reviewed as necessary within EBOC at Texas Children’s Hospital. Content Expert Teams are involved with every review and update.

**Disclaimer**

Practice recommendations are based upon the evidence available at the time the clinical standard was developed. Clinical standards (guidelines, summaries, or pathways) do not set out the standard of care and are not intended to be used to dictate a course of care. Each physician/practitioner must use his or her independent judgment in the management of any specific patient and is responsible, in consultation with the patient and/or the patient’s family, to make the ultimate judgment regarding care.

**Version History**

<table>
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<th>Date</th>
<th>Comments</th>
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<tr>
<td>July 2022</td>
<td>Clinical Standard Originally Completed</td>
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<tr>
<td>Aug 2022</td>
<td>Algorithm Wording Revised</td>
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