Asthma

CLINICAL CARE GUIDELINES

Information for Healthcare Providers

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Target Population

Intended for patients:
- 2 years or older
- Who are being treated for asthma or an asthma exacerbation
- Who have a first time wheeze with a history consistent with asthma

Not intended for patients who:
- Are under treatment for bronchiolitis, viral pneumonitis, aspiration pneumonia, or croup
- Have chronic lung disease, bronchopulmonary dysplasia (BPD), cystic fibrosis, airways anomalies (e.g. tracheomalacia), cardiac disease, or neurologic disorders

Key Treatment Principles

(All treatment recommendations follow NAEPP guidelines unless otherwise specified)

Indicated:
- Diagnosis of asthma
- Classification of disease severity/level of control for all patients treated for asthma. Controller medications are indicated for persistent asthma
- Treatment of asthma exacerbations in the hospital require inhaled beta-2 agonist for symptoms of airway obstruction and systemic steroids for asthma exacerbations
- Asthma education and individualized Asthma Action Plan for all.

Note: The recommendations presented in this Children’s Hospital Colorado (CHCO) Clinical Care Guideline (CCG) were developed using the best available evidence, current as of the time of publication. It is recommended that clinicians refer to our website at childrenscolorado.org to access the most current version of this CCG, as this document will undergo periodic revisions and updates.

This CCG is designed to assist clinicians and patients make appropriate healthcare decisions and should not be considered inclusive of all appropriate methods of care reasonably directed at obtaining similar results, nor is it a substitute for consultation with a qualified healthcare provider. We do not recommend the self-management of healthcare issues.

Clinical Management

Diagnosing Asthma

1. Suspect asthma in any child with episodic symptoms of airflow obstruction (cough, wheeze, shortness of breath) that is at least partially reversible with a bronchodilator
2. Rule out other causes of airway obstruction such as cystic fibrosis, recurrent aspiration, airway anomalies (such as tracheomalacia), GERD, sinusitis, and foreign body aspiration
Asthma Severity Assessment

1. Intermittent vs. Persistent asthma:
   a. Persistent asthma is diagnosed if the child has any of the following:
      - symptoms more than twice per week during the day
      - symptoms twice per month at night
      - any exercise limitation
      - FEV1 less than 80% predicted (for children over 5 years)
      - Two or more steroid bursts for asthma in 12 months

2. Treat Persistent asthma with a daily controller medication such as inhaled corticosteroids (See Figure 1: Algorithm for Asthma Management-Outpatient and Table 1: Dosage of Daily Controller Medication for Asthma Control)

Keys to Managing Any Asthma Exacerbation

1. Telephone Triage
   a. Mild (dyspnea with activities and/or peak flow greater than 80% of personal best) → Primary Care Provider (PCP) contact AND short acting bronchodilator every 4 hours.
   b. Moderate (Dyspnea interfering with activities and peak flow 50 to 80% of personal best) → Same day clinic visit AND short acting bronchodilator every 4 hours AND consider home prednisone.
   c. Severe (Dyspnea interfering with speech and peak flow 50 to 80% of personal best) → Emergency Department (ED) visit AND repeat short acting bronchodilator every 20 minutes up to 3 doses.
   d. Life Threatening (Severe difficulty breathing, not able to speak, cyanosis, combative, agitated or difficult to arouse) → Activate EMS.

2. Clinical assessment:
   a. History:
      - Evaluate current symptom severity and recent bronchodilator use and history of exposures to asthma triggers.
      - Obtain asthma exacerbation history: History of ED visit or hospitalization in the last year, ICU admission ever
      - Rate chronic asthma severity assessment (intermittent vs. persistent) and initiate treatment
   b. Physical exam: (Quality of evidence: C)
      - Evaluate for cough, wheeze, tachypnea, increased work of breathing, low oxygen saturation
      - Use Pediatric Asthma Severity (PAS) Score to guide intervention & response to treatment. PAS score includes the following elements: Respiratory rate, Oxygen requirements, Auscultation, Retractions, Dyspnea (See Table 2: Pediatric Asthma Score)
   c. Laboratory and radiologic studies
      - Chest X-Ray: Consider if high fever, history of choking and/or foreign body aspiration, delayed symptom resolution, persistent asymmetric lung exam.
      - NOTE: A normal chest exam does not exclude asthma.
Clinical Care Guidelines for Treatment of Asthma Exacerbations:

1. **Outpatient**: See [Figure 1: Outpatient Chronic Asthma Management](#), [Figure 2: Stepwise Approach to Asthma Treatment](#) and [Figure 3: Algorithm for Asthma Exacerbation Management—Outpatient Clinic](#)

2. **Emergency Department**: See [Figure 4: Algorithm for Asthma Management- Emergency Department](#)

3. **Inpatient**: See [Figure 5: Algorithm for Asthma Management--Inpatient](#)

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- **Arterial or venous blood gas**: Consider in cases with impending respiratory failure.

**Treatment** *(Quality of Evidence: A)*

1. **Therapeutics**:
   a. **Oxygen**: Start supplemental oxygen for any child whose oxygen saturation is less than 90%. Increase as needed.
   b. **Short-acting beta-agonist (SABA)**: Used for reversal of bronchospasm. **SABAs should be used in every child admitted to the hospital** for asthma. See [Figure 6: Progression Through the Bronchodilator Weaning Protocol](#), [Table 3: Dosage of Medications for Asthma Exacerbations](#), and [Table 4: Bronchodilator Weaning Protocol](#)
   c. **Systemic corticosteroids** should be used in all children admitted to the hospital for asthma. Steroids are recommended early in the course of an exacerbation for children who do not respond quickly or completely to inhaled beta-agonists. Oral corticosteroids have similar bioavailability to parenteral steroids. The 2007 NHLBI guidelines do not endorse doubling inhaled corticosteroid dosing.
   d. **Emergency treatment for impending respiratory failure** per Emergency Department ([Figure 4](#)) and Inpatient ([Figure 5](#)) Guidelines. For medication dosing recommendations, see [Table 3](#) and [Table 4](#).

2. **Education**: Provide asthma education throughout stay and an individualized action plan upon discharge

3. **Follow up**: Follow up with patient’s primary care provider should be arranged within 3 to 5 days of discharge or treatment in any setting.

4. **Consulting asthma specialists** (pulmonary or allergy) for any patient with:
   a. ICU admission for asthma
   b. Exacerbation complicated or triggered by complicating illnesses such as allergies
   c. Need for extensive education
   d. Questioning the diagnosis of asthma

Please refer all high risk asthma patients seen at Children’s Hospital Colorado (CHCO) to the high risk asthma clinic at CHCO or back to their asthma specialist. (High risk = 1 or more hospitalizations or 2 or more ED visits in 12 months or an ICU admission ever)

5. **Consult social work** in any child/family which has trouble obtaining medications or complying with the recommended therapy for asthma.
Children’s Hospital Colorado High Risk Asthma Program:

The high risk asthma program will be notified about any child who has been admitted to the hospital for asthma or who has been seen in our emergency department for asthma more than twice in 12 months. A letter to the primary care provider (PCP) will be sent after the index visit episode to notify the PCP that their patient is at high risk for another severe asthma exacerbation. If the PCP approved or if we do not hear from the PCP that they would not like to have their patient contacted, a letter will be sent to the family to reinforce asthma education and to offer an appointment in the high risk asthma clinic to any patient not already followed by an asthma specialist.
**Figure 1: Algorithm for Asthma Management-Outpatient**

### Asthma Management for Children and Adults (age 5+ yrs)
Good asthma control reduces the risk of exacerbations and long-term pulmonary damage.

#### Make the Diagnosis
1. Consider the diagnosis of asthma if symptoms include: recurrent coughing, wheezing or shortness of breath relieved by a bronchodilator.
2. Spirometry: ≥12% increase of FEV₁, post-bronchodilator.
3. Consider co-morbidities or alternate diagnosis, especially if poor control: GERD, aspiration, airway anomaly, foreign body, cystic fibrosis, vocal cord dysfunction, tobacco/secondhand smoke exposure, or COPD. GERD is a common co-morbidity.
4. If diagnosis in doubt, consult with an asthma specialist.

#### Key Points of Assessment and Treatment
1. Asthma is a variable disease and needs to be assessed at every visit.
2. Use the Assess Asthma Control box to guide your assessment and make treatment decisions.
3. The goal of asthma therapy is to keep the patient in control as much as possible with the least amount of medication.
4. If at first visit the patient is not well-controlled (see below), begin controller therapy. A patient should be diagnosed with Persistent Asthma if he/she needs a daily controller medication to stay in control.

#### Assess Asthma Control (determination of level of control is dictated by the criterion at the lowest level of control)

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Well-Controlled</th>
<th>Not Well-Controlled</th>
<th>Very Poorly Controlled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daytime symptoms</td>
<td>≤2 days/week</td>
<td>&gt;2 days/week</td>
<td>Throughout the day</td>
</tr>
<tr>
<td>Nighttime awakenings</td>
<td>≤2 times/month</td>
<td>1-3 times/week</td>
<td>≥4 times/night</td>
</tr>
<tr>
<td>Limitation of activities</td>
<td>None</td>
<td>Some limitation</td>
<td>Extremely limited</td>
</tr>
<tr>
<td>Short-acting β₂-agonist use</td>
<td>≤2 days/week</td>
<td>&gt;2 days/week</td>
<td>Several times per day</td>
</tr>
<tr>
<td>Asthma Control Test (ACT)²</td>
<td>Score of ≥20</td>
<td>Score of 16-19</td>
<td>Score of ≤15</td>
</tr>
<tr>
<td>Courses of prednisone in last year</td>
<td>≤2</td>
<td>≥2</td>
<td>≥2</td>
</tr>
<tr>
<td>Spirometry²</td>
<td>FEV₁ % predicted&lt;80% predicted or personal best Normal ratio for age</td>
<td>60-80% predicted or personal best ≤5% decrease in ratio for age</td>
<td>&lt;60% predicted or personal best &gt;5% decrease in ratio for age</td>
</tr>
<tr>
<td>FEV₁/FVC:</td>
<td>5-19 yrs ≥85%</td>
<td>20-39 yrs ≥80%</td>
<td>40-59 yrs ≥75%</td>
</tr>
</tbody>
</table>

#### If Well-Controlled:
- Follow the Stepwise Approach Guideline (see page 2). Consider step down if well-controlled for 3 consecutive months. Re-assess every 1 to 6 months.

#### If Not Well-Controlled:
- Follow the Stepwise Approach Guideline. If initial visit, start at Step 2. Step up until well-controlled. Re-assess in 2 to 6 weeks. For side effects, consider alternative treatment.

#### If Very Poorly Controlled:
- Consider course of prednisone (1-2 mg/kg, daily max 60 mg). If initial visit, start at Step 2. Step up 1-2 steps using Stepwise Approach Guideline. Re-assess in 2 weeks.

#### Other Things to Consider at Every Visit
- Check adherence and address possible poor adherence to medication.
- Review environmental factors: e.g., pets, cigarette smoke, perfume, allergy season, respiratory infection.
- Provide self-management education.
- Develop and review a written asthma control plan in partnership with the patient.
- Integrate education into all points of care where healthcare professionals interact with patient.
- Review inhaler technique. Encourage use of spacers with all MDIs.
- Treat co-morbid conditions: rhinitis and sinusitis, obesity, gastroesophageal reflux, obstructive sleep apnea, stress, depression or anxiety, allergic bronchopulmonary aspergillosis.

*For the full ACT go to www.healthteamworks.org/guidelines/asthma.html
²Spirometry is suggested annually and/or any time the clinical picture changes or does not make sense.
**Figure 3: Algorithm for Asthma Exacerbation Management—Outpatient Clinic**

**Intended for:** Children 2 years or older with a history of asthma, albuterol use, or episodic symptoms of airflow obstruction (recurrent cough and/or wheeze), or at least partially reversible, includes first time episode

**NOT Intended for:** Children less than 2 years old; co-morbid conditions, including but not limited to: chronic lung disease, cystic fibrosis, cardiac disease, bronchiolitis, croup/stridor, aspiration, neurological disorders

**Triage RN/MA:**
- Check HR, RR, temp, pulse ox
- Triage level as appropriate
- Bring patient to room
- Notify attending physician if patient in severe distress (RR greater than 35, oxygen saturation less than 90%, speaks in single words/trouble breathing at rest)

**Primary RN:**
- Give oxygen to keep pulse oximetry greater than 90%
- Perform PAS (score below) if possible

**Treatment**

1. Give nebulized or MDI³ albuterol up to 3 doses. Albuterol dosing is 0.15 to 0.3mg/kg per 2007 NHLBI guidelines.
   - Less than 20 kg: 2.5 mg neb x 3 or 2 to 4 puffs MDI albuterol x 3
   - 20 kg or greater: 5 mg neb x 3 or 4 to 8 puffs MDI albuterol x 3

   **Note:** For moderate (dyspnea interferes with activities)/severe (dyspnea at rest) exacerbations you can add atrovent to nebulized albuterol at 0.5mg/neb x 3.

2. Repeat PAS score after treatments
3. Repeat vital signs every 30 minutes
4. Prednisone or equivalent 2 mg/kg orally with a maximum dose of 80 mg should be given if there is not complete response** after one treatment dose
   (Contraindications: varicella, varicella exposure, tuberculosis, severe respiratory distress, recent [within 2 weeks] steroids)

**Incomplete Response**

- Discharge home if stable for 1 to 2 hours after last bronchodilator therapy
- Intensify home albuterol therapy to every 4 hours
- Oral Steroids for 5 days if needed
- Follow-up scheduled
- Asthma Education and MDI teaching
- Re-label medications for home if possible

**Complete Response**

- No response or incomplete response to 3 back to back treatments OR
- Oxygen saturations below 90% on room air OR
- Requiring nebulizer treatments more often than every 2 hours

**ED transfer criteria**

**Complete response is defined as oxygen saturations over 90%, no significant increased work of breathing. (PAS less than 7)**
Figure 4: Algorithm for Asthma Management– Emergency Department

**Intended for:** Children 2 years or older with a history of asthma, albuterol use, or episodic symptoms of airflow obstruction (recurrent cough and/or wheeze), or at least partially reversible, includes first time episode

**NOT Intended for:** Children less than 2 years old; co-morbid conditions, including but not limited to: chronic lung disease, cystic fibrosis, cardiac disease, bronchiolitis, croup/stridor, aspiration, neurological disorders

**Triage RN/Primary RN:** Routine vital signs and check saturation, blood pressure and height

**Primary RN:**
- Initiate Bronchodilator Weaning Protocol using ED/Nursing asthma order set and perform Pediatric Asthma Score (PAS)
- Oxygen to keep SpO₂ greater than 90%
- Notify respiratory therapy

**RT or RN:**
- Give combination ipratropium bromide 0.5 mg nebulized with albuterol (weight specific dosing below) for a total of up to three initial treatments⁸,⁹
- Repeat PAS after nebs and
- Prednisone (or equivalent) 2mg/kg orally with a maximum dose of 80 mg to any child with a PAS score over 7 after the first nebulizer treatment and not contraindicated

**Discharge criteria: PAS less than 7 and SpO₂ 90% or greater on room air (RA)**

**Discharge Plan**
- Home bronchodilator therapy every 4 hours for 72 hours until seen by PCP or until completing oral steroids
- Prescribe oral steroids for patients receiving 2 or more albuterol treatments and consider if patient has a history of severe asthma exacerbations
- Prescribe fluticasone propionate (Flovent) 44 mcg if the patient has one prior ED visit and/or hospitalization within the last 12 months and they are not already on a controller medication
- Asthma Education and Asthma Action Plan
- If needed, provide phone number(s) for potential PCP.
- Re-label beta agonist for home use

**Good Response**
- PAS 5 to 7 within 30 minutes of completing nebs AND SpO₂ greater than 90% on room air (RA)
- Observe for at least 60 minutes
- VS (HR, RR, SpO₂), PAS in 1 hour
- If PAS 8 or if hypoxic, treat as “INCOMPLETE RESPONSE”

**Incomplete Response (PAS 8 to 11) or Poor Response (PAS 12 to 15) with saturation less than 90%**

**PAS 8-11, For patients still on continuous nebs:**
- Observe for 2 hours
- If PAS is 8 or more, put back on continuous nebs and monitor hourly.
- If PAS less than 8 at 2 hours give 2-8 puffs Albuterol MDI and wean as tolerated and consider discharge

**PAS < 8, Once patient is off continuous:**
- Place on cardio-respiratory monitor with VS (HR, RR, SpO₂) every hour
- Begin systemic corticosteroids
- Albuterol continuous neb with oxygen as needed to keep saturations >90%

**Discharge criteria: PAS less than 7 and SpO₂ 90% or greater on RA**

**ICU**
- Requires more than one dose of IV magnesium, terbutaline infusion, or subcutaneous epinephrine
- Continuous neb requirements below
- Albuterol every 2 hrs or stable on continuous albuterol neb for at least 1 hour

**FLOOR**
- Continuous neb requirements below
- Normal mental status

**Admit Criteria: Unable to wean albuterol to every 2 hours or SpO₂ less than 90% on room air. ** RT and floor RN must be notified before transfer to the inpatient unit**

**Dose**

<table>
<thead>
<tr>
<th>Weight</th>
<th>Dose</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 20 kg</td>
<td>2.5 mg</td>
<td>times 3</td>
</tr>
<tr>
<td>20 kg or more</td>
<td>5 mg</td>
<td>times 3</td>
</tr>
</tbody>
</table>

Recheck in one hour:
- If PAS less than 8, go off continuous
- If PAS is 8 or more put the child back on continuous
- If PAS is 12 or greater, go to “Poor Response” below.

**PAS > 12, Poor Response:**
- Consider ABG and CXR
- Increase albuterol per ED attending and adjunct therapies such as IV magnesium, noninvasive ventilation, or subcutaneous terbutaline
- Consult ICU

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Figure 5: Algorithm for Asthma Management--Inpatient

**Intended for** patients:
- 2 years or older who are being treated for asthma or an asthma exacerbation, includes first time wheeze

**NOT intended for** patients who:
- Are under treatment for bronchiolitis, viral pneumonia, aspiration pneumonia, or croup
- Have chronic lung disease, BPD, cystic fibrosis, airway anomalies (e.g., tracheomalacia), cardiac disease, or neurologic disorders

**Initial assessment:**
- Vital signs, \( SPO_2 \), PAS score
- Chronic asthma severity
- Continuous monitoring **only if on continuous nebulizer**

**Guideline and bronchodilator wean eligible?**

**Monitoring:**
- Routine vital signs per protocol including PAS score per Asthma Clinical Care Guideline as appropriate
- Continuous pulse oximeter and CVR monitoring **only while on continuous nebulizer**
- **IV access** is only needed in a child who is being admitted to the Intensive Care Unit or who is not tolerating liquids or oral corticosteroid therapy or otherwise clinically indicated

**Intended for** patients:
- Inpatient Initial assessment:
  - Vital signs, \( SPO_2 \), PAS score
  - Chronic asthma severity
  - Continuous monitoring **only if on continuous nebulizer**

**Guideline and bronchodilator wean eligible?**

**YES**
- **Can still use asthma order set**

**NO**
- **Clinically indicated care**

**Is child improving?**

**NO**

**YES**
- Does child meet discharge criteria?
  - Patient on room air
  - Beta agonist required every four hours
  - Family able to manage care (if not, consider consulting social work)

**Discharge Plan**
- Controller for persistent asthma
- Oral steroids
- Home bronchodilator therapy every 4 hours for 72 hours or until completing oral steroids
- Finalize Asthma Education and Asthma Action Plan during Phase 3
- Place orders for re-label of asthma medications for home use and send to pharmacy during Phase 4.
- If needed, provide phone number(s) for potential PCP. Assist in arranging follow up care.

**Does child meet discharge criteria?**

**NO**
- Continue inpatient management

**YES**
- Continue inpatient management and consider consulting pulmonary.
  - If patient requires continuous albuterol for more than 12 hours, remove patient from continuous for 15-30 minutes and re-evaluate.
  - If the trial off of continuous albuterol fails, consider alternate diagnosis, consult pulmonary, and discontinue the protocol.

**Continue inpatient management**
**Figure 6: Progression through the Bronchodilator Weaning Protocol**

**Intended for:** patients 2 years or older who are being treated for asthma or an asthma exacerbation, including first time wheeze

**NOT Intended for:** patients less than 2 years old; co-morbid conditions, including but not limited to: chronic lung disease, cystic fibrosis, cardiac disease, bronchiolitis, croup/stridor, aspiration, neurological disorders

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**NORMAL PROGRESSION**

**Advance Phase**
- If PAS improved by 2 or more
  - OR PAS 7 or less
  - OR If PAS has not improved by at least 2
    - But is NOT getting worse
    - AND In phase 12 hours or more

**Continue Current Phase**
- If PAS is less than 12
  - AND Has not improved by at least 2
  - AND In phase less than 12 hours

If in phase 1 for 12 hours, attempt 15-30 minute trial off of continuous nebs

  - **If tolerated:** Advance
  - **If fails:** Place back on continuous neb, discontinue the protocol and NOTIFY MD

**ABERRANT COURSE**

**Intensification**
- If at any time PAS is more than 7
  - AND worsens by 2 or more
  - OR PAS is 12 or more
  - OR PAS worsens by more than 2 within 1 hour after advancing

**INTENSIFY AND NOTIFY Bedside RN and MD**

- If PAS improves by 2 or more
  - AND PAS 11 or less

  - **Continue Current Phase**

- If PAS has not improved by at least 2
  - OR PAS is 12 or more
  - OR The patient is worsening

**NOTIFY MD**

- If PAS 11 or less

  - **RE-EVALUATE In less than 1 HOUR**

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### CLINICAL CARE GUIDELINES

**Table 1: Dosage of Daily Controller Medication for Asthma Control**

**NOTE:** Products that are underlined bold text are available on the inpatient formulary at Children’s Hospital Colorado

<table>
<thead>
<tr>
<th>Inhaled Corticosteroid Controller Medications</th>
<th>FDA Approved Age (yrs)</th>
<th>Dosage (Total Daily Inhalations)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low Dose</td>
<td>Medium Dose</td>
</tr>
<tr>
<td></td>
<td>less than 12 years of age</td>
<td>greater than 12 years of age/adults</td>
</tr>
<tr>
<td><strong>On Children’s Hospital Colorado Formulary</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Advair® Diskus®</strong> (fluticasone/salmeterol) DPI*</td>
<td>4+</td>
<td>(100/50)</td>
</tr>
<tr>
<td><strong>Asmanex® (mometasone) 110 mcg DPI</strong></td>
<td>4+</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Flovent® HFA (fluticasone) 44 mcg MDI</strong></td>
<td>4+</td>
<td>2 to 4</td>
</tr>
<tr>
<td><strong>Flovent® HFA (fluticasone) 110 mcg MDI</strong></td>
<td>4+</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Pulmicort Respules® (budesonide) 0.25, 0.5, or 1 mg</strong></td>
<td>1+</td>
<td>0.5mg</td>
</tr>
<tr>
<td><strong>Symbicort® (budesonide/formoterol) 80/4.5 MDI</strong></td>
<td>12+</td>
<td>2 to 4</td>
</tr>
<tr>
<td><strong>Symbicort® (budesonide/formoterol) 160/4.5 MDI</strong></td>
<td>12+</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Not on Children’s Hospital Colorado Formulary</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Dulera® (mometasone/formoterol) MDI</strong></td>
<td>12+</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Flovent® HFA (fluticasone) 220 mcg MDI</strong></td>
<td>4+</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Flovent® Diskus® (fluticasone) 50 mcg DPI</strong></td>
<td>4+</td>
<td>2 to 4</td>
</tr>
<tr>
<td><strong>Pulmicort Flexhaler® (budesonide) 90 mcg DPI</strong></td>
<td>6+</td>
<td>2 to 4</td>
</tr>
<tr>
<td><strong>Pulmicort Flexhaler® (budesonide) 180 mcg DPI</strong></td>
<td>6+</td>
<td>1 to 2</td>
</tr>
<tr>
<td><strong>QVAR® HFA (beclomethasone) 40 mcg MDI</strong></td>
<td>5+</td>
<td>2 to 4</td>
</tr>
<tr>
<td><strong>QVAR® HFA (beclomethasone) 80 mcg MDI</strong></td>
<td>5+</td>
<td>1 to 2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Leukotriene Blocker Controller Medications</th>
<th>FDA approved age</th>
<th>Dosage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Singulair® (montelukast) 4 mg chewable tablet</strong></td>
<td>2 to 5 years</td>
<td>1 tablet orally once daily in evening</td>
</tr>
<tr>
<td><strong>Singulair® (montelukast) 5 mg chewable tablet</strong></td>
<td>6 to 14 years</td>
<td>1 tablet orally once daily in evening</td>
</tr>
<tr>
<td><strong>Singulair® (montelukast) 10 mg tablet</strong></td>
<td>15+ years</td>
<td>1 tablet orally once daily in evening</td>
</tr>
<tr>
<td><strong>Not on Children’s Hospital Colorado Formulary</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Accolate® (zafirlukast) 10 mg tablet</strong></td>
<td>5 to 11 years</td>
<td>1 tablet orally TWICE daily</td>
</tr>
<tr>
<td><strong>Accolate® (zafirlukast) 20 mg tablet</strong></td>
<td>12+ years</td>
<td>1 tablet orally TWICE daily</td>
</tr>
<tr>
<td><strong>Singulair® (montelukast) 4 mg granule packet</strong></td>
<td>12 to 23 months</td>
<td>1 packet orally once daily in evening</td>
</tr>
<tr>
<td><strong>Zyflo CR® (zileutin) 600 mg tablet</strong></td>
<td>12+ years</td>
<td>2 tablets orally TWICE daily</td>
</tr>
</tbody>
</table>
Table 2: Pediatric Asthma Severity (PAS) Score

**NOTE:** Use PAS Score to guide intervention & response to treatment. *Older pediatric asthma patients may exhibit lower PAS scoring during an exacerbation.*

<table>
<thead>
<tr>
<th>Score</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Respiratory rate</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 to 3 years</td>
<td>34 or less</td>
<td>35 to 39</td>
<td>40 or greater</td>
</tr>
<tr>
<td>4 to 5 years</td>
<td>30 or less</td>
<td>31 to 35</td>
<td>36 or greater</td>
</tr>
<tr>
<td>6 to 12 years</td>
<td>26 or less</td>
<td>27 to 30</td>
<td>31 or greater</td>
</tr>
<tr>
<td>older than 12 years</td>
<td>23 or less</td>
<td>24 to 27</td>
<td>28 or greater</td>
</tr>
<tr>
<td><strong>Oxygen requirements</strong></td>
<td>Greater than 90% on room air</td>
<td>85% to 90% on room air</td>
<td>Less than 85% on room air</td>
</tr>
<tr>
<td><strong>Auscultation</strong></td>
<td>Normal breath sounds to end-expiratory wheeze only</td>
<td>Expiratory wheezing</td>
<td>Inspiratory and expiratory wheezing to diminished breath sounds or poor aeration</td>
</tr>
<tr>
<td><strong>Retractions</strong></td>
<td>Zero to one site</td>
<td>Two sites</td>
<td>Three or more sites</td>
</tr>
<tr>
<td><strong>Dyspnea</strong></td>
<td>Speaks in sentences, coos and babbles</td>
<td>Speaks in partial sentences, short cry</td>
<td>Speaks in single words/short phrases/grunting</td>
</tr>
</tbody>
</table>
### Table 3: Dosage of Medications for Asthma Exacerbations

<table>
<thead>
<tr>
<th>Medication</th>
<th>Children 12 years and younger</th>
<th>Adult or Children over 12 years</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inhaled Short-Acting Beta&lt;sub&gt;2&lt;/sub&gt;-Agonists (SABA):</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Albuterol: <em>Intermittent Nebulizer solution</em> (Available 0.63mg/3mL, 1.25mg/3mL, 2.5mg/3mL, 5 mg/mL)</td>
<td>0.15 mg/kg (minimum dose 2.5 mg) every 20 Minutes for 3 doses the 0.15 to 0.3 mg/kg up to 10 mg every 1 to 4 hours as needed</td>
<td>2.5 to 5 mg every 20 minutes for 3 doses, then 2.5 to 10 mg every 1 to 4 hours as needed</td>
<td>Only selective beta&lt;sub&gt;2&lt;/sub&gt;-agonists are recommended. For optimal delivery, dilute aerosols to minimum of 3 mL at gas flow of 8 L/min. May mix with ipratropium nebulizer solution.</td>
</tr>
<tr>
<td>Albuterol: <em>Continuous Nebulizer solution</em> (Available 0.63mg/3mL, 1.25mg/3mL, 2.5mg/3mL, 5 mg/mL)</td>
<td>20 kg or more: 10 mg/hour Less than 20 kg: 7.5 mg/hour</td>
<td>10 mg/hour continuously</td>
<td>Use large volume nebulizers for continuous administration. May mix with ipratropium nebulizer solution. <strong>For higher doses, ICU transfer is required at CHCO</strong></td>
</tr>
<tr>
<td>Albuterol: MDI (Available 90 mcg/puff)</td>
<td>4 to 8 puffs every 20 minutes for 3 doses, then every 1 to 4 hours. Use valved holding chamber (VHC); add mask in children less than 4-6 years of age.</td>
<td>4 to 8 puffs every 20 minutes up to 4 hours, then every 1 to 4 as needed.</td>
<td>In mild to moderate exacerbations, MDI plus VHC is as effective as nebulized therapy with appropriate administration technique and coaching by trained personnel</td>
</tr>
<tr>
<td><strong>Levalbuterol/R-albuterol</strong> <em>(See Restrictions)</em>: Nebulizer solution (Available 0.63 mg/3 mL, 1.25 mg/0.5 mL, 1.25 mg/3 mL)</td>
<td>0.075 mg/kg (minimum dose 1.25 mg) every 20 minutes for 3 doses, then 0.075 to 0.15 mg/kg up to 5 mg every 1 to 4 hours as needed.</td>
<td>1.25 to 2.5 mg every 20 minutes for 3 doses, then 1.25 to 5 mg every 1 to 4 hours as needed</td>
<td>Levalbuterol administered in one-half the mg dose of albuterol provides comparable efficacy and safety. Has not been evaluated by continuous nebulization. The following restrictions apply to the use of Levalbuterol: a) The patient has failed albuterol therapy b) The patient has experienced side effects from albuterol c) The patient has allergies to the preservatives in albuterol d) The patient is on Levalbuterol therapy on admission</td>
</tr>
<tr>
<td>Levalbuterol /R-albuterol** <em>(See Restrictions)</em>: MDI (Available 45mcg/puff)</td>
<td>See albuterol MDI dosing</td>
<td>See albuterol MDI dosing</td>
<td>See restrictions for Levalbuterol nebulizer solution above.</td>
</tr>
<tr>
<td><strong>Systemic ( Injected ) Beta&lt;sub&gt;2&lt;/sub&gt;-Agonists: PICU must be notified (RRT required) AND limited to one dose on the floor. Second dose may be given only if transfer to the PICU is delayed.</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Epinephrine: <em>(Available 1:1,000 1mg/mL)</em></td>
<td>0.01 mg/kg up to 0.3 to 0.5 mg every 20 minutes for 3 doses subcutaneously</td>
<td>0.3 to 0.5 mg every 20 minutes for 3 doses subcutaneously</td>
<td>No proven advantage of systemic therapy over aerosol.</td>
</tr>
<tr>
<td>Medication</td>
<td>Children 12 years and younger</td>
<td>Adult or Children over 12 years</td>
<td>Comments</td>
</tr>
<tr>
<td>---------------</td>
<td>--------------------------------</td>
<td>---------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Terbutaline</strong>: <strong>RRT required to administer on the floor</strong> <em>(Available 1mg/mL)</em></td>
<td>0.01 mg/kg every 20 minutes for 3 doses, then every 2 to 6 hours as needed subcutaneously. Maximum 0.3mg/dose</td>
<td>0.25 mg every 20 minutes for 3 doses subcutaneously</td>
<td>No proven advantage of systemic therapy over aerosol. Subcutaneous Terbutaline can be used to intensify a patient who is on continuously nebulized albuterol.</td>
</tr>
<tr>
<td>Theophylline: <strong>RRT required to administer on the floor</strong></td>
<td>If no theophylline given in the last 24 hours, initial dose is 5 mg/kg. If theophylline has been given in the last 24 hours; initial dose is 2.5 mg/kg. Maintenance dose and monitoring per CHCO pharmacy formulary.</td>
<td>Not recommended by the national asthma guidelines due to the narrow window of clinical efficacy and risk of adverse effects.</td>
<td></td>
</tr>
<tr>
<td><strong>Anticholinergics:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ipratropium Nebulizer solution</strong> <em>(Available in 2.5 mL vial containing 0.5 mg ipratropium bromide, may be mixed with Albuterol)</em></td>
<td>0.5mg can be given up to 3 times and then as needed.</td>
<td>0.5mg can be given up to 3 times and then as needed.</td>
<td>May be used for up to 3 times in the initial management of severe exacerbations. The addition of Ipratropium to albuterol has not been shown to provide further benefit once the patient is hospitalized.</td>
</tr>
<tr>
<td><strong>Systemic Corticosteroids:</strong> Note: Intravenous route should only be used if patient is unable to tolerate oral intake or in cases of impending respiratory failure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Prednisone or Methylprednisolone or Prednisolone</strong></td>
<td>2 mg/kg in 2 divided doses (Maximum = 60 mg/day outpatient and 80 mg/day inpatient/ED)</td>
<td>40 to 80 mg/day in 1 to 2 divided doses</td>
<td>For outpatient “bursts”: In adults, can be dosed in single or 2 divided doses for total of 5 to 10 days. In children: 1 to 2 mg/kg/day for 3 to 10 days</td>
</tr>
<tr>
<td>Medication</td>
<td>Children 12 years and younger</td>
<td>Adult or Children over 12 years</td>
<td>Comments</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-------------------------------</td>
<td>--------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Adjunct Treatments for Exacerbation:</strong> Only to be used in the Emergency Department or PICU</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Magnesium sulfate (IV)  | 40 mg/kg IV over 30 minutes. Maximum: 2g | 40 mg/kg IV over 30 minutes. Maximum: 2g | For use in life-threatening exacerbations and in those whose exacerbations remains severe after 1 hour of intensive conventional therapy.患者在ED中给予一次镁剂并在1小时后稳定可以转移至普通病房。

Patients given one dose of Magnesium in the ED and stable 1 hour after administration can be transferred to the General Care floors.
Table 4: Bronchodilator Weaning Protocol:
For patients 2 years or older, who are being treated for asthma or an asthma exacerbation. Any patient with asthma on the floor (including PICU transfers) can be placed on this protocol. Children should be taken off of the protocol if they require more than one intensification per phase, fail a trial off of continuous, or by provider discretion. Once taken off the protocol, the Provider will determine/order timing of bronchodilator wean.

<table>
<thead>
<tr>
<th>PHASE 1</th>
<th>PHASE 2</th>
<th>PHASE 3</th>
<th>PHASE 4</th>
<th>INTENSIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Nebulizer: <strong>Albuterol</strong> Weight: Dose</td>
<td>Albuterol every 2 hours via MDI/VHC Weight: Dose</td>
<td>Albuterol every 3 hours via MDI/VHC Weight: Dose</td>
<td>Albuterol every 4 hours via MDI/VHC Weight: Dose</td>
<td>Albuterol via nebulizer times one Weight: Dose</td>
</tr>
<tr>
<td>More than 20 kg: 10 mg/hour</td>
<td>More than 20 kg: 8 puffs</td>
<td>More than 20 kg: 8 puffs</td>
<td>More than 20 kg: 4 puffs</td>
<td>More than 20 kg: 10 mg</td>
</tr>
<tr>
<td>Less than 20 kg: 7.5 mg/hour</td>
<td>Less than 20 kg: 4 puffs</td>
<td>Less than 20 kg: 4 puffs</td>
<td>Less than 20 kg: 2 puffs</td>
<td>Less than 20 kg: 7.5 mg</td>
</tr>
<tr>
<td><strong>Patients requiring higher doses of continuous albuterol must be transferred to the PICU</strong></td>
<td>-OR-</td>
<td>-OR-</td>
<td>-OR-</td>
<td>-OR-</td>
</tr>
<tr>
<td></td>
<td>Albuterol every 2 hours via neb Weight: Dose</td>
<td>Albuterol every 3 hours via neb Weight: Dose</td>
<td>Albuterol 2.5 mg every 4 hours via neb</td>
<td>Albuterol via MDI/VHC Weight: Dose</td>
</tr>
<tr>
<td></td>
<td>More than 20 kg: 5 mg</td>
<td>More than 20 kg: 5 mg</td>
<td>More than 20 kg: 2.5 mg</td>
<td>More than 20 kg: 10 puffs</td>
</tr>
<tr>
<td></td>
<td>Less than 20 kg: 2.5 mg</td>
<td>Less than 20 kg: 2.5 mg</td>
<td>Less than 20 kg: 6 puffs</td>
<td>Less than 20 kg: 6 puffs</td>
</tr>
<tr>
<td></td>
<td><strong>Consider subcutaneous terbutaline if intensifying while on continuous nebulizer. (See Table 3 for dosing and requirements.)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Systemic Corticosteroids** delivered every 12 hours at 1/mg/kg up to 80 mg/day.

<table>
<thead>
<tr>
<th>RT evaluate every 2 hours</th>
<th>RT evaluate every 3 hours</th>
<th>RT evaluate every 4 hours</th>
<th>RT evaluate in 1 hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR, RR, SpO2, RA.</td>
<td>HR, RR, SpO2, RA.</td>
<td>HR, RR, SpO2, RA.</td>
<td>HR, RR, SpO2, RA.</td>
</tr>
<tr>
<td>Pediatric Asthma Severity Score (PAS)</td>
<td>Pediatric Asthma Severity Score (PAS)</td>
<td>Pediatric Asthma Severity Score (PAS)</td>
<td>Pediatric Asthma Severity Score (PAS)</td>
</tr>
<tr>
<td>Initiate education on “what is asthma”, signs and symptoms, and triggers</td>
<td>Peak flow Education (&gt;6 yrs.)</td>
<td>Peak flow Education (&gt;6 yrs.)</td>
<td>Peak flow Education (&gt;6 yrs.)</td>
</tr>
<tr>
<td>RT evaluate every 2 hours</td>
<td>RT evaluate every 4 hours</td>
<td>RT evaluate in 1 hour</td>
<td></td>
</tr>
<tr>
<td>HR, RR, SpO2, RA.</td>
<td>HR, RR, SpO2, RA.</td>
<td>HR, RR, SpO2, RA.</td>
<td></td>
</tr>
<tr>
<td>Pediatric Asthma Severity Score (PAS)</td>
<td>Pediatric Asthma Severity Score (PAS)</td>
<td>Pediatric Asthma Severity Score (PAS)</td>
<td>Pediatric Asthma Severity Score (PAS)</td>
</tr>
<tr>
<td>Initiate education on MDI with VHC use (handout)</td>
<td>BPA triggers for AAP and asthma teaching. Finalize discharge training. Check understanding of key concepts, device technique, review meds, and AAP.</td>
<td>BPA triggers for RT to re-label meds for home use.</td>
<td></td>
</tr>
<tr>
<td>RN evaluate every 2 hours</td>
<td>RN evaluate every 4 hours</td>
<td>RN evaluate in 1 hour</td>
<td></td>
</tr>
<tr>
<td>Continuous SpO2, HR, RR, with full cardiorespiratory assessment. BP Q4hr</td>
<td>Spot check SpO2, HR, RR, with full cardiorespiratory assessment. BP Q4hr</td>
<td>Continuous SpO2, HR, RR, check BP, full cardiorespiratory assessment. BP Q4hr</td>
<td></td>
</tr>
<tr>
<td>RN evaluate every 2 hours</td>
<td>RN evaluate every 4 hours</td>
<td>Provider</td>
<td></td>
</tr>
<tr>
<td>Spot check SpO2, HR, RR, with full cardiorespiratory assessment. BP Q4hr</td>
<td>Spot check SpO2, HR, RR, with full cardiorespiratory assessment. BP Q4hr</td>
<td>Review AAP</td>
<td></td>
</tr>
<tr>
<td>Provider</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Add controller medications.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verify orders for AAP/Education</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Patient and Primary Caregiver Education**\(^{15,16}\) *(Quality of Evidence: D)*

- Asthma education will be provided throughout episode of treatment, including PCP, specialist visit, ED and inpatient.
- Best Practice Alerts (BPAs) will be triggered at phase 3 to alert the RT to complete the asthma action plan (AAP) and to finalize discharge asthma education; and at phase 4 to remind RT to issue an order to re-label asthma medications and to send to pharmacy.
- An asthma action plan will be completed for all children who are discharged from the hospital with a primary diagnosis of asthma. Any child diagnosed with reactive airway disease (RAD) in the medical record is considered to have the same diagnosis as asthma. *Creation of an AAP for any patient receiving scheduled albuterol treatments should be considered"*\(^{17}\).
- The action plan should include controller medications (or “no controller indicated”), triggers (check the H&P note), and follow up provider and phone number (cannot state “Parent Smart Number.” May use Child Health Clinic and phone number for all non-established PCP’s at discharge. At any site where EPIC is used, the action plan can be found under Letters (Please make sure to use correct AAP for your area: i.e. ED, Clinic, Inpatient, etc….)
- Patient and primary caregiver need to demonstrate understanding of signs and symptoms, medication and device use, patient specific asthma triggers, peak flow education/monitoring (when applicable) and the Asthma Action Plan.
- RN/RT need to document in EPIC that education and the asthma action plan has been completed.
- Smoke avoidance and cessation counseling referral will be provided to patients and primary caregivers as indicated.

**Parent/Caregiver Education Materials**

<table>
<thead>
<tr>
<th>English</th>
<th>Spanish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asthma Action Plan</td>
<td>Asthma Action Plan</td>
</tr>
<tr>
<td>Asthma and the Environment</td>
<td>Asthma and the Environment</td>
</tr>
<tr>
<td>Asthma: What is it?</td>
<td>Asthma: What is it?</td>
</tr>
<tr>
<td>Diskus</td>
<td>Diskus</td>
</tr>
<tr>
<td>Home nebulizer treatments</td>
<td>Home nebulizer treatments</td>
</tr>
<tr>
<td>Metered dose inhaler</td>
<td>Metered dose inhaler</td>
</tr>
<tr>
<td>Peak flow meter</td>
<td>Peak flow meter</td>
</tr>
</tbody>
</table>
## Measures and Targets

<table>
<thead>
<tr>
<th>#</th>
<th>Measures</th>
<th>Location</th>
<th>CHCO Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>% with an ICU admission</td>
<td>IP</td>
<td>&lt;10%</td>
</tr>
<tr>
<td>2</td>
<td>Median LOS(^\text{\textsuperscript{\textdagger}}) (Days)</td>
<td>IP</td>
<td>&lt;2.5</td>
</tr>
<tr>
<td>3</td>
<td>Median LOS (hours)</td>
<td>ED</td>
<td>&lt;4</td>
</tr>
<tr>
<td>4</td>
<td>Inpatient Readmission Rate-30 Days(^\text{\textdagger})</td>
<td>IP</td>
<td>&lt;2%</td>
</tr>
<tr>
<td></td>
<td>Inpatient Readmission Rate-12 months(^\text{\textdagger})</td>
<td>IP</td>
<td>&lt;30%</td>
</tr>
<tr>
<td>5</td>
<td>ED Return Rate - 30 Days *</td>
<td>ED</td>
<td>&lt;2%</td>
</tr>
<tr>
<td>6</td>
<td>High Risk Patients --Outpatient Clinic visit (within 90 days)--ED/Obs or Inpatient Admission (within 12 months)</td>
<td>Clinic</td>
<td>&lt;30%</td>
</tr>
<tr>
<td>7</td>
<td>Inpatient Asthma Action Plan Joint Commission compliant(^{17})</td>
<td>IP</td>
<td>&gt;95%</td>
</tr>
</tbody>
</table>

\(^{\text{\textdagger}}\) Median LOS: Median IP length of stay in days. Monitored annually

\(^\text{\textdagger}\) Numerator: Returns to IP/Obs within 30 days. Denominator: Total # of IP cases

\(*\) Numerator: Returns to ED within 30 Days. Denominator: Total # of ED cases

\(!\) Yearly Measure. High Risk Patients defined as having >=2 ED/Obs or 1 Inpatient Visit

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**Related Children’s Hospital Colorado Documents**

- Noninvasive ventilation
- Rapid Response Team
- Monitoring procedure
References


Additional related literature

General:
The role of clinical care pathways in the treatment of pediatric asthma:

The impact of clinical care pathways on house staff:
Stoller JK, Michnick I. Medical house staff impressions regarding the impact of a respiratory therapy consult service. *Respir Care.* 1998;43:549-551.

Continuous nebulization for the treatment of acute asthma exacerbation

Ipratropium bromide:

Nebulizers vs metered-dose inhalers with valved holding chambers:

Noninvasive ventilation:

Inhaled corticosteroids:
Specialty care:

**Appraisal of Evidence**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Evidence Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Well-designed, randomized controlled trials or diagnostic studies on relevant populations</td>
</tr>
<tr>
<td>B</td>
<td>RCTs or diagnostic studies with minor limitations; overwhelmingly consistent evidence from observational studies</td>
</tr>
<tr>
<td>C</td>
<td>Observational studies (case control and cohort design)</td>
</tr>
<tr>
<td>D</td>
<td>Expert opinion, case reports, reasoning from first principles</td>
</tr>
<tr>
<td>X</td>
<td>Exceptional situations where validating studies cannot be performed and there is a clear preponderance of benefit or harm</td>
</tr>
</tbody>
</table>

**Approved by**
Pharmacy and Therapeutics Committee 12/05/2013
The Children’s Hospital Colorado Guideline Review Committee 12/05/2013
Scheduled for review for invalidating evidence on 12/05/2014
Scheduled for full review on 12/05/2016

**Manual/Department**
Clinical Care Guidelines

**Origination Date**
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**Last Date of Review or Revision**
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**Approved By**
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Chief Quality Officer

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