RECOMMENDATIONS see Algorithm A (Adult) and Algorithm B (Pediatric) for specific recommendations.

Assessment of Severity

♦ In addition to vital signs and clinical measures, an objective measure of the severity of airflow obstruction should be determined.
   (see Algorithms A and B)

Bronchodilators

♦ Inhaled β-agonists are first line therapy for the emergency management of asthma.

♦ Bronchodilators should be administered by the inhaled route in preference to the parenteral route for the majority of asthmatics.

♦ Bronchodilators should be titrated using objective and clinical measures of airflow obstruction to guide the dose and frequency of administration.

♦ Anticholinergic bronchodilators should be added to β-agonists for severe asthma and may be helpful for moderate asthma.

Corticosteroids

♦ Corticosteroids are recommended in the early management of acute asthma

- Oral agents are preferred to IV agents except in those too ill to swallow.

♦ All patients discharged from the site of emergency management for acute asthma should be considered for a course of oral corticosteroid therapy.

♦ In addition to oral corticosteroids, inhaled corticosteroids should be considered for all patients with asthma at discharge.

Additional Therapies

♦ IV magnesium sulfate treatment should be considered for patients with severe asthma.

♦ Other drugs that can be used in the management of severe asthma are: adrenaline, IV salbutamol, and inhaled corticosteroids.
   (see Algorithms A and B)

♦ Antibiotics are commonly over-used in acute asthma; they should be reserved for obvious bacterial infection.

Delivery Devices

♦ A metered dose inhaler (MDI) with a spacer device is as effective as nebulization in patients with mild to moderate acute asthma.

- In children, an MDI with spacer produces fewer side effects than nebulization.

Discharge

♦ A discharge plan and clear instructions for follow-up should be prepared for patients discharged from home.

- A written action plan is recommended. (Refer to Chronic Asthma Guideline for further management)
BACKGROUND

Asthma is a common disease in both children and adults; current Alberta estimates suggest 13% of children and 7% of adults have this disorder.1 The burden of disease related to asthma in Canada is hard to quantify because deaths and hospitalization rates are underestimates of the disability and loss of enjoyment of life experienced by Canadians with this condition.2 Fatal asthma is increasing worldwide, and Alberta has one of the highest rates of fatal asthma in Canada. Acute asthma costs in Canada are high, with emergency department ($22 million) and in-patient costs ($84 million) exceeding $100 million per year.3 Despite improved understanding of the disease and pharmacological options, death and hospitalization still occur.4 Appropriate emergency department (ED) or equivalent management of acute asthma will have an impact on these statistics. Reviews of ED care in Canada have concluded that the condition is often under treated in this setting.

Assessment of Severity

Methods of assessment include past asthma history, clinical (vital signs, including pulse oximetry where available, and physical examination), and pulmonary function testing. It has been consistently shown that the severity of airflow obstruction in asthmatic exacerbations correlates poorly with the traditionally assessed clinical signs of obstruction (e.g., wheezing). Many patients may have near normal physical findings yet will have clinically important obstruction when spirometric tests are performed. Similarly, changes in clinical signs after treatment do not always reflect changes in spirometry results. Furthermore, it has been shown that physician predictors of peak expiratory flow rates (PEFR) are frequently inaccurate.

The standard outcome measures used in the acute setting to assess severity of airflow obstruction are PEF and forced expiratory volume in 1 second (FEV₁).6 There is a high correlation between improvements in these two parameters following bronchodilator treatment. The best value of 3 attempts at each measurement should be recorded when possible. Because optimal results are patient effort dependent, specially trained personnel (Respiratory Therapist, Nurse, MD) should be present to monitor the procedure.

Studies have suggested that percent predicted values are not more useful than absolute values in making clinical decisions. However, subjects were young (<40 years old) and unlikely to have had any component of fixed airway obstruction (e.g., COPD). To be consistent with all patient groups, recording the PEFR or FEV₁ according to the percent of previous best, if known, or the percent of predicted based on simple nomograms, is recommended. Observing the change over time of pulmonary function test results is an important component in the assessment of response to therapy.

Physician estimates of response to therapy are often inaccurate in acute asthma, yet several studies have shown that failure to substantially improve PEFR or FEV₁ in response to initial bronchodilator therapy is predictive of a more prolonged attack course, or even the need for hospitalization. Thus, objective measurement of post-bronchodilator response is the best method of predicting outcome of the asthma attack.

Treatment

Oxygen

Oxygen therapy should be instituted in acute asthma where hypoxia has been demonstrated.

Bronchodilators

Inhaled ß-agonists are first line therapy for the emergency management of asthma.6,7 Bronchodilators should be administered by the inhaled route in preference to the parenteral route for the majority of asthmatics.6,8 Bronchodilators should be titrated using objective and clinical measures of airflow obstruction to guide the dose and frequency of administration.6,7,8,10

Inhaled ß-agonists produce the fastest relief of acute bronchospasm with the fewest side effects.6 Prior treatment with aerosolized (MDI or wet nebulization) ß-agonists does not preclude successful reversal of airway obstruction.6 Two multicentre trials comparing aerosolized ß-agonists to IV ß-agonists demonstrate that aerosolized ß-agonists are more effective and safer than intravenous salbutamol for acute asthma.6,7 Use of intravenous bronchodilators
should be restricted to selected patients.

The dose of aerosolized or intravenous β-agonist necessary to reverse an asthmatic attack has not been standardized. A patient’s ability to use the aerosol route, the efficiency of the delivery system, the relative amounts of bronchospasm versus airway narrowing due to inflammatory mucosal edema and secretions, and unpredictable patient factors such as reduced sensitivity or down regulation of beta receptors in severe asthma all influence drug dosing. Relief of bronchospasm in response to aerosolized bronchodilators is best achieved if the principle of cumulative dosing is followed, in which sequential doses build upon the therapeutic effects of previously administered doses. The frequency of dosing will be determined by the patient’s response and by the time required to completely nebulize the dose. Dosing every 15-20 minutes by wet nebulization, or even continuous wet nebulization, may be necessary initially, because of the inherent low efficiency of these devices. The optimal number of puffs, from an MDI with spacer, in the setting of acute asthma is not known. The British Thoracic Society recommends 20 - 40 puffs may be necessary, and CAEP suggests 4-8 puffs Q 15-20 minutes with the recognition that it may be necessary to increase the dose to 1 puff Q 30-60 seconds.

Ventilated asthmatics with refractory bronchospasm, not responding to conventional bronchodilators may respond to inhalational anaesthetic agents with bronchodilating properties such as ether, halothane, enflurane, or isoflurane. Problems encountered with this approach include the potential for hypotension and cardiac dysrhythmias, probably exacerbated by the hypoxemia often seen in these patients.

Bronchodilator dose adjustment should be made by following objective measures of airway obstruction and symptoms. Once maximum relief of obstruction has been achieved by bronchodilators, administering further doses by any route will provide no further clinical benefit, but may have the potential for toxicity.

Anticholinergics

- Anticholinergic bronchodilators should be added to β-agonists for severe asthma and may be helpful for moderate asthma.

A systematic review of the use of anticholinergics in children and a recent study have demonstrated evidence of improvement in lung function and reductions in admission rates (30%) in children with severe asthma. The studies done on mild to moderate asthma using single doses of ipratropium have shown limited benefit. However, some lung function improvements in moderate asthma may warrant its use in this setting as well.

Less consensus exists for the use of ipratropium bromide in adults with acute asthma. Disparate findings suggest that a conservative approach should be adopted. In adults, the use of anticholinergics should be reserved for patients not responding to β-agonists or with severe symptoms.

Corticosteroids

- Corticosteroids are recommended in the early management of acute asthma
  - Oral agents are preferred to IV agents except in those too ill to swallow.
- All patients discharged for acute asthma should be considered for a course of oral corticosteroid therapy.
- In addition to oral corticosteroids, inhaled corticosteroids should be considered for all patients with acute asthma at discharge.

The early use of systemic corticosteroids has been recommended on the basis of a systematic review. These reviews suggest that the early administration of corticosteroids may reduce admissions to hospital. Moreover, the treatment appears to be most effective in the patients who have severe asthma and who have not received inhaled corticosteroids during their presentation. The delivery of corticosteroids in the ED is an important consideration. Research suggests that oral and IV agents function equally effectively. Therefore, it is recommended that the
A corticosteroid should be administered early, and by mouth; IV treatment should be reserved for those too dyspneic to swallow. The number of patients requiring intravenous agents should be small. Oral prednisone/prednisolone (1 mg/kg for children; 50 mg for adults) or intravenous corticosteroids (solucortef or methylprednisolone) may be used.

**Additional Therapies**

**Magnesium Sulfate**

- IV magnesium sulfate treatment should be considered for patients with severe asthma.

A number of randomized clinical trials have examined the use of intravenous magnesium sulfate for the treatment of acute asthma in the ED; most involve children and the others involve adult subjects. In general, the use of magnesium is not supported for all patients seen in the ED. However, there is evidence that in severe asthma (children: <50% predicted PEFR and not responding to therapy; adults: <30% predicted PEFR and not responding to therapy), magnesium does provide additional benefit when combined with standard medications (e.g., corticosteroids, oxygen, β-agonists, etc.). Specifically, it provides approximately 10% improvement in the percentage predicted pulmonary functions (PFT’s). There is also evidence that patients respond faster, are discharged earlier, and that the admission rate is lower when magnesium is used. In general, magnesium is inexpensive to administer, is safe in the doses prescribed for asthma, and is well tolerated (no major side effects reported in the trials). In adults, magnesium should be administered over 20 minutes and the dose is generally 2 grams.

In children, the dose is 25 mg/kg IV over 20 minutes. Magnesium can be administered more rapidly in severe cases. The use of magnesium is recommended for severe cases of asthma presenting to the ED and not responding to traditional measures.

**Aminophylline**

Over the years, the use of aminophylline in acute asthma has fallen from favor. Systematic reviews evaluating randomized controlled trials of aminophylline compared to placebo in the acute treatment of adults and children with acute asthma, both clearly demonstrated a lack of benefit in major outcomes such as pulmonary functions and admissions. It is interesting to note both reviews identified excessive side effects, which outweighed the benefits of aminophylline in this setting. Currently, this agent would constitute an option only for patients where all other modalities had failed (β-agonists, corticosteroids, ipratropium bromide, magnesium, oxygen, intravenous salbutamol, etc.), and should be used cautiously.

Additional therapies have been used in acute severe asthma. For example, high dose inhaled corticosteroids have been shown to improve pulmonary functions in some asthmatic patients. In addition, epinephrine has a long history of use in acute allergic reactions such as asthma, and should be considered in severe asthma.

Antibiotics are NOT effective in the early management of acute asthma, unless the patient has obvious signs and symptoms of a bacterial infection.

If the patient is not responding to the therapies in this guideline, early patient referral or transfer is recommended.

**Delivery Devices**

- A metered dose inhaler (MDI) with a spacer device is as effective as nebulization in patients with mild to moderate acute asthma.
  - In children, an MDI with spacer produces fewer side effects than nebulization.

In a large systematic review, aerosolized bronchodilators administered by wet nebulization or metered dose inhalers during acute asthma were shown to be equally efficacious. In both adults and children, comparisons between the two failed to demonstrate superiority of either method with respect to traditional outcomes such as pulmonary functions and admission rates. However, especially in children, the use of the wet nebulizers produced more of the autonomic side effects. Since the dose...
comparisons for MDI with spacer to nebulizer in these studies were unequal, caution is warranted when deciding on therapy. Therefore, site specific decisions on the method of delivery must be based on other issues such as cost, physician familiarity, and supporting resources (i.e., respiratory therapy and nursing staff availability).

**Discharge**

The PEF/FEV<sub>1</sub> values are general guides to assist in clinical decision making. However, individual patient factors must also be taken into account. Patients with severe obstruction initially or severe residual obstruction after treatment are at high risk (>75% probability) for relapse and will usually require admission or prolonged observation. Conversely, patients who exhibit only mild residual obstruction can be discharged with a high degree of confidence. It is difficult to determine the most appropriate disposition in patients who exhibit moderate residual obstruction. In these patients, an asthma risk profile should be considered (see below). The higher the risk profiles, the lower the threshold for recommending admission in this group of patients.

**Asthma Risk Profile**

Important risk factors that define asthma at high risk of destabilization and relapse include the following:

- hospital admission or acute asthma in the previous 12 months,
- recent systemic corticosteroid use,
- use of multiple asthma medications,
- maximum use of asthma medications,
- previous severe or near death asthma attack,
- psychosocial problems,
- frequent use of inhaled β-agonists.
- environmental triggers.

The more high risk severe asthma markers in the patient’s history, the more cautious the physician should be about discharge and the more closely the patient should be followed.

**Corticosteroids Following Discharge**

There are at least 7 trials comparing the use of corticosteroids (oral or IM) or placebo in asthmatics discharged from the ED after treatment for an exacerbation. The result of the systematic review suggested that patients benefited in all outcomes from the administration of corticosteroids. First, patients experienced 65% fewer relapses in the first week. Second, the use of β-agonists was also reduced within the first week of care. Finally, the use of corticosteroids is safe, inexpensive and well tolerated by patients. No patient subgroup was identified who would benefit more from this therapy, so it is advisable that this treatment should be considered in all exacerbations.

The dose and method of delivery for corticosteroids is debatable. There is no evidence that the short-course of corticosteroids used needs to be “tapered”. Most research would suggest that patients treated with corticosteroids could be given medications for 7 to 10 days; in Canada, prednisone is the most common agent. Compliance may be highest for adults with 50 mg once daily for a 7 days. Intra-muscular corticosteroids are also effective in cases of poor follow-up, financial concerns, or concerns with compliance. Longer courses of corticosteroids may be required for selected patients.

**Inhaled Corticosteroids (ICS) Following Discharge**

While the evidence for the use of inhaled corticosteroids (ICS) in chronic asthma is strong and consistent, the role of ICS in acute asthma is poorly defined. For patients on ICS at the time of presentation, maintenance of the ICS is important. The recommendations for these patients consist of enhancing compliance, avoiding side effects, and asthma education.

For those patients not receiving regular ICS, a recent randomized controlled trial has demonstrated a 45% reduction in relapses over the first 3 weeks of treatment by the addition of high dose ICS (1600 ug/day of budesonide). Other studies are being performed on different agents, doses and delivery systems, and the recommendations should be strengthened with the next year. It appears that patients should be started on ICS at discharge in addition to oral corticosteroids. Less is known about whether patients with mild exacerbations may be safely discharged on ICS alone, despite reports of this success.
Other Agents at Discharge

Currently, there is no evidence for the addition of other agents at discharge after an acute exacerbation such as the leukotriene antagonists, antibiotics, longer-acting β-agonists, or antihistamines. Short-acting β-agonists should be used for relief over the follow-up period on a ‘prn’ basis.

Discharge Planning

♦ A discharge plan and clear instructions for follow-up should be prepared for patients discharged home.
・ A written action plan is recommended.

Most experts believe that asthma education is the key to optimal disease control. Optimal disease control is achieved by ensuring proper drug delivery technique, and optimizing compliance by improved understanding of pathophysiology and pharmacology. Through assessment, demonstration, education and evaluation, the patient should leave the acute care setting with a general understanding of how to manage their asthma at home. This should include an understanding of how to use their delivery device, when to seek help, what signs and symptoms suggest early interventions, when to use each medication and where to seek education and information.

Patients should be given brief written treatment plans with clear instructions for aftercare at home including review of drug delivery technique (proper techniques and appropriate use). Spirometric results from the acute care setting would be included in this plan.

To locate potential sources of information please refer to the Alberta Asthma Resource Catalogue

REFERENCES

The Alberta Clinical Practice Guidelines Program promotes appropriate, effective and quality medical care in Alberta by supporting the use of clinical practice guidelines. The program is administered by the Alberta Medical Association under the direction of a multi-stakeholder steering committee.

**Alberta Clinical Practice Guidelines Steering Committee**

- Alberta Health
- Alberta Medical Association
- College of Family Physicians of Canada, Alberta Chapter
- College of Physicians and Surgeons of Alberta
- Physicians at Large
- Public Representative
- Regional Health Authorities
- University of Alberta
- University of Calgary

**TO PROVIDE FEEDBACK**

The Asthma Working Group is a multidisciplinary team composed of emergency and family physicians, pulmonary specialists, radiologists, nurses, imaging technologists, public health specialists, and members of the public.

The Working Group encourages your feedback. If you need further information or if you have difficulty applying this guideline, please contact:

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EDMONTON, AB T5N 3Z1
(780) 482-2626
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**Acute Asthma - September 1999**
Reviewed November 2002
### ALGORITHM A: EMERGENCY MANAGEMENT OF ADULT ASTHMA

**Emergency Department Assessment and Treatment of Adults**

<table>
<thead>
<tr>
<th>ASSESSMENT</th>
<th>PRE-TREATMENT</th>
<th>TREATMENT</th>
<th>NOT IMPROVED</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MILD</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• exertional dyspnea/cough</td>
<td>• PEFR/FEV₁ &gt; 60% predicted or personal best (PEFR &gt; 300 L/min FEV₁ &gt; 2.1 L)*</td>
<td>• ± O₂</td>
<td>Reassess to evaluate response to treatment</td>
</tr>
<tr>
<td>• ± nocturnal symptoms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• increased use of β-agonists</td>
<td></td>
<td>• β-agonists (MDI + chamber)</td>
<td></td>
</tr>
<tr>
<td>• good response to β-agonists</td>
<td></td>
<td>• ± corticosteroids</td>
<td></td>
</tr>
</tbody>
</table>

| **MODERATE** | | | |
| • dyspnea at rest | • PEFR/FEV₁ 40-60% predicted or personal best (PEFR 200 - 300 L/min FEV₁ 1.6 - 2.1 L)* | • O₂ | |
| • cough | | | |
| • nocturnal symptoms | | • β-agonists (MDI + chamber) | |
| • partial relief from β-agonists | | • systemic corticosteroids | |
| • β-agonists needed > 8 puffs/day | | • anticholinergics may be helpful in some cases | |
| • chest tightness | | | |

| **SEVERE** | | | |
| • laboured respirations | • O₂ saturation <90% | • 100% O₂ | |
| • agitated, diaphoretic | • PEFR/FEV₁ unable or <40% predicted or personal best (PEFR <200 L/min FEV₁ <1.6 L)* | • frequent or continuous β-agonists | |
| • difficulty speaking | | • frequent or continuous anticholinergics | |
| • tachycardic | | • systemic corticosteroids | |
| • no relief with β-agonists | | • systemic magnesium sulfate | |

| **NEAR DEATH** | | | |
| • exhausted, confused | • O₂ saturation <90% (despite supplemental O₂) | • consider alternative drugs: IV β-agonists, inhalational anesthetic agents, aminophylline, epinephrine, etc. | |
| • diaphoretic, cyanotic | • PEFR/FEV₁ not appropriate | | |
| • silent chest, ↓ resp. effort | | | |
| • falling heart rate | | | |

*Note: Approx values for the “average” adult. Predicted or personal best are more appropriate. PEFR, FEV₁ (predicted) based on age, sex, height. Pre-post treatment PEFR, FEV₁ are probably the best guides to therapy.*
Recommended Emergency Department Drug Usage for Adults

**β-agonists: first line bronchodilators - titrate to response**

- inhaled salbutamol: 100 µg/puff
  - MDI 4-8 puffs q 15-20 min x 3 is usual
  - ↑ to 1 puff q 30-60 sec (pause 30 seconds between puffs)

- wet nebulizer salbutamol solution: 2.5 - 5.0 mg
  - q 15-20 min. x 3; continuous if necessary, delivered with O₂ at 6-8 L/min.
  - ↑ dose for intubated patients

**Systemic Corticosteroids: first line preventer therapy - oral preferred if can tolerate**

- Prednisone 40-60 mg (PO)
- Hydrocortisone 500 mg (IV)
- Methylprednisone 125 mg (IV)

**Additional Drugs (not usually required) May be associated with more toxicity**

Patients unresponsive to treatment may benefit from IV β-agonists or inhalational anesthetic agents. These forms of therapy may require consultation with respiraology, ICU, anesthesia or internal medicine.

- Adrenaline (1:1000) SC 0.3-0.5 ml q 15-20 min prn (D5W = 4 µg/ml)
  - IV infusion: 4-8 µg/min.

- Salbutamol (IV solution only)
  - Load: 4 µg/Kg (over 2-5 min)
  - IV infusion: 0.1 - 0.2 µg/Kg/min

- Aminophylline: Load 3-6 mg/Kg IV over 30 min (1/2 dose if already taking). Infusion: 0.2 - 1.0 mg/Kg/h (follow levels). Not usually recommended as bronchodilator in the first 24 hours of treatment.

  - Inhaled corticosteroids

**Intubation agents:**

- Induction: Ketamine 1.5 mg/Kg IV
- Paralysis: Succinylcholine 1.5 mg/Kg IV
- Vecuronium 0.15 mg/Kg for maintenance of paralysis only

**Anticholinergics**

- inhaled ipratropium bromide (20 µg/puff)
  - MDI 4-8 puffs q 15-20 min x 3 is usual
  - ↑ to 1 puff q 30-60 sec (4-20 puffs) prn

- wet nebulizer ipratropium solution: 250 - 500 µg
  - q 15-20 min. x 3; continuous if necessary
  - ↓ frequency in recovery phase
  - may be mixed with β-agonists

**Magnesium Sulfate**

- 2 grams IV over 20 minutes as bolus

**OXYGEN**

- Will not suppress respiratory drive in acute asthma
- Start high (FIO₂ 40-100%) when indicated
- achieve O₂ saturation > 92%
- Flow 6-8 L/min with wet nebulizer

**Inhaled corticosteroids**

Start high (FIO₂ 40-100%) when indicated
achieve O₂ saturation > 92%
Flow 6-8 L/min with wet nebulizer

**Anticholinergics**

- e.g., inhaled ipratropium bromide (20 µg/puff)
  - MDI 4-8 puffs q 15-20 min x 3 is usual
  - ↑ to 1 puff q 30-60 sec (4-20 puffs) prn

- e.g., wet nebulizer ipratropium solution: 250 - 500 µg
  - q 15-20 min. x 3; continuous if necessary
  - ↓ frequency in recovery phase
  - may be mixed with β-agonists
## Discharge Treatment Plan for Adults

### Medications

A. **β-agonists**
   1. Regular use often required for 48 hours
   2. PRN use after 48 hours if symptoms controlled
   3. If unable to control symptoms with regular dose β-agonists return to ED or see your physician

B. **Corticosteroids**
   1. Oral indicated for most patients
   2. Prednisone: 50 mg/day for 7 days as a non-tapered dose
   3. Individual plans based on past treatment/recent symptoms
   4. Inhaled corticosteroids should be continued at previous dose and reviewed with family physician
   5. Inhaled corticosteroids: Initiate at 500-1000 µg/day (Beclomethasone or equivalent). Higher doses may be necessary. Consider as integral part of long term management.

C. **Other medications**
   1. To be continued on discharge
   2. Role in long term management to be assessed by primary care provider or consultant.

D. **Antibiotics**
   1. Antibiotics are not first line treatment and should be reserved for patients that fail to respond to aggressive anti-inflammatory therapy.

### Patient Instructions

**Review**
1. Drug delivery technique, role, dosing and schedule (puffer, spacer device, powder delivery)
2. Role of relievers (β-agonists) and preventers (anti-inflammatory)
3. Role of trigger avoidance

**Explain: when to seek treatment**
1. Treatment failure: indications for emergency assessment or physician advice (based on signs, symptoms and medication requirements, e.g., dose [number and frequency of puffs] of β-agonists required for relief or control of symptoms).
2. Worsening/persisting symptoms, modify dose and schedule of steroid therapy. Follow up with family physician or consultant in 1-7 days to assess response.

**Educate**
1. Provide patient with written instructions at discharge
2. Provide patient with accompanying patient brochure
3. When to seek physician advice or return to ED

**Follow-up**
1. Consider respirology, asthma clinic, internal medicine, allergy/immunology consultation for high risk patients.
   - refer to the Alberta Asthma Resource Catalogue
   - refer to the CPG for the diagnosis and management of chronic asthma
# ALGORITHM B: EMERGENCY MANAGEMENT OF PEDIATRIC ASTHMA

## Emergency Department Assessment and Treatment for Pediatrics

<table>
<thead>
<tr>
<th>ASSESSMENT</th>
<th>PRE-TREATMENT</th>
<th>TREATMENT</th>
<th>NOT IMPROVED</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MILD</strong></td>
<td>• nocturnal cough</td>
<td>• ± O₂</td>
<td>• ± O₂</td>
</tr>
<tr>
<td></td>
<td>• exertional dyspnea</td>
<td>• ± O₂, β–agonists</td>
<td>• β–agonists</td>
</tr>
<tr>
<td></td>
<td>• increased use of β–agonists</td>
<td>• consider systemic corticosteroids</td>
<td>• systemic corticosteroids</td>
</tr>
<tr>
<td></td>
<td>• good response to β–agonists</td>
<td></td>
<td>• consider anticholinergic</td>
</tr>
<tr>
<td><strong>MODERATE</strong></td>
<td>• normal mental status</td>
<td>• O₂ saturation 92%-95%</td>
<td>• O₂ 100%</td>
</tr>
<tr>
<td></td>
<td>• abbreviated speech</td>
<td>• PEFR/FEV₁ &lt;75% predicted or personal best</td>
<td>• β–agonists</td>
</tr>
<tr>
<td></td>
<td>• dyspnea at rest</td>
<td></td>
<td>• systemic corticosteroids</td>
</tr>
<tr>
<td></td>
<td>• partial relief with β–agonists and required more than q. 4h</td>
<td></td>
<td>• consider anticholinergic</td>
</tr>
<tr>
<td><strong>SEVERE</strong></td>
<td>• altered mental status</td>
<td>• O₂ saturation &lt;92%</td>
<td>• 100% O₂</td>
</tr>
<tr>
<td></td>
<td>• difficulty speaking</td>
<td>• PEFR/FEV₁ &lt;50% predicted or personal best</td>
<td>• continuous or frequent β–agonists</td>
</tr>
<tr>
<td></td>
<td>• laboured respirations</td>
<td></td>
<td>• systemic corticosteroids</td>
</tr>
<tr>
<td></td>
<td>• persistant tachycardia</td>
<td></td>
<td>• systemic magnesium sulfate</td>
</tr>
<tr>
<td></td>
<td>• no prehospital relief with β–agonists at usual dose</td>
<td></td>
<td>• consider anticholinergic</td>
</tr>
<tr>
<td></td>
<td>• decreased respiratory effort</td>
<td></td>
<td>• consider methylxanthines</td>
</tr>
<tr>
<td><strong>NEAR DEATH</strong></td>
<td>• exhausted, confused</td>
<td>• O₂ saturation &lt;80%</td>
<td>• consider alternative drugs: IV β–agonists,</td>
</tr>
<tr>
<td></td>
<td>• diaphoretic, cyanotic</td>
<td></td>
<td>inhalational anesthetic agents, aminophylline,</td>
</tr>
<tr>
<td></td>
<td>• apnea</td>
<td></td>
<td>epinephrine, etc.</td>
</tr>
<tr>
<td></td>
<td>• decreased respiratory effort</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• falling heart rate</td>
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<td></td>
</tr>
</tbody>
</table>

**IF NEAR DEATH OR DETERIORATING**

RAPID SEQUENCE INTUBATION

Note: Spirometry (≥ 6 years old) and O₂ saturations are not always accurate predictors of severity. USE AS GUIDES ONLY.
<table>
<thead>
<tr>
<th><strong>Recommended Emergency Department Drug Doses for Pediatrics</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>β–agonists: first line bronchodilator - titrate to response</strong></td>
</tr>
<tr>
<td>e.g., inhaled salbutamol: 100 µg/puff</td>
</tr>
<tr>
<td>• MDI 0.3 puffs/kg (max 10 puffs) pause 30 seconds between puffs</td>
</tr>
<tr>
<td>e.g., wet nebulizer salbutamol solution 0.15 mg/kg (0.03 ml/kg max 1 ml) Mix in 3 ml NS</td>
</tr>
<tr>
<td>• give with O₂ (meet manufacturers flow specifications)</td>
</tr>
<tr>
<td><strong>Systemic Corticosteroids: first line preventer therapy - oral preferred if patient can tolerate</strong></td>
</tr>
<tr>
<td>• Predisone 1-2 mg/kg (PO)</td>
</tr>
<tr>
<td>• Hydrocortisone 5-7 mg/kg (IV)</td>
</tr>
<tr>
<td>• Methylprednisone 1-2 mg/kg (IV)</td>
</tr>
<tr>
<td><strong>Additional Drugs</strong> (Not usually required) May be Associated With More Toxicity</td>
</tr>
<tr>
<td>Patients unresponsive to treatment may benefit from IV β–agonists or inhalational anesthetic agents. These forms of therapy may require consultation with respirology, anesthesia or ICU.</td>
</tr>
<tr>
<td>• Adrenaline (1:1000) S.C. 0.01 ml/kg (max 0.5 ml) q 15-20 min prn for anaphylaxis or if unable to administer inhaled β–agonists</td>
</tr>
<tr>
<td>• Salbutamol IV: dilute 5 ml of IV infusion solution (1 mg/ml) in 500 ml D5W (10 µg/ml). Load 7.5 µg/kg over 2-5 minutes Infusion 1-10 µg/kg/min.</td>
</tr>
<tr>
<td><strong>Intubation agents:</strong></td>
</tr>
<tr>
<td>• Pretreatment: Atropine 0.02 mg/kg IV</td>
</tr>
<tr>
<td>• Sedation: Midazolam 0.1 mg/kg IV</td>
</tr>
<tr>
<td>• Induction: Ketamine 1.5 mg/kg IV</td>
</tr>
<tr>
<td>• Paralysis: Succinylcholine 1.5 mg/kg IV</td>
</tr>
<tr>
<td>• Pancuronium 0.1 mg/kg IV for maintenance of paralysis only</td>
</tr>
<tr>
<td><strong>OXYGEN</strong></td>
</tr>
<tr>
<td>Start high (F O₂ 100%)</td>
</tr>
<tr>
<td>Achieve O₂ saturation 92-95%</td>
</tr>
<tr>
<td><strong>Magnesium Sulfate</strong></td>
</tr>
<tr>
<td>• 25 mg/kg IV over 20 min. as bolus (maximum of 2 gm/v)</td>
</tr>
<tr>
<td><strong>Anticholinergics</strong></td>
</tr>
<tr>
<td>e.g., inhaled ipratropium bromide</td>
</tr>
<tr>
<td>• wet nebulizer 250-500 µg</td>
</tr>
<tr>
<td>• MDI 3-6 puffs (20 µg/puff) q 20-120 min. combined with salbutamol</td>
</tr>
<tr>
<td><strong>Will not suppress respiratory drive in acute asthma</strong></td>
</tr>
</tbody>
</table>
### Discharge Treatment Plan for Pediatrics

#### ALWAYS CONSIDER RISK FACTORS FOR RELAPSE

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altered mental status, cyanosis, apnea, persistent respiratory distress</td>
<td>Tertiary Care/ICU admission</td>
</tr>
<tr>
<td>Inadequate response to 3 doses of bronchodilators, relapse in less than 1 hour</td>
<td>Admission recommended</td>
</tr>
<tr>
<td>If good response to therapy known to be available at home, no relapse with observation 1-3 hours post treatment (spirometry &gt; 75% predicted/personal best; O₂ saturation &gt; 95%)</td>
<td>Discharge likely</td>
</tr>
</tbody>
</table>

#### Reference values for PEFR (≥6 years old) age, effort and understanding influence reliability

<table>
<thead>
<tr>
<th>Height (cm)</th>
<th>Height (in)</th>
<th>Male (L/min)</th>
<th>Female (L/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>110</td>
<td>43</td>
<td>160</td>
<td>145</td>
</tr>
<tr>
<td>115</td>
<td>45</td>
<td>175</td>
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<td>491</td>
<td>407</td>
</tr>
<tr>
<td>180</td>
<td>71</td>
<td></td>
<td>441</td>
</tr>
</tbody>
</table>

#### Patients at Risk for Relapse

1. Previous ICU admission or intubation
2. Recent ED visits
3. Frequent hospitalizations
4. Systemic corticosteroid dependent or recent use.
5. Sudden attacks
6. Allergic/anaphylactic triggers
7. Prolonged duration of recent attack
8. Poor understanding
9. Returning to same environmental triggers
10. Slow response to therapy in ED
11. Inadequate anti-inflammatory treatment at discharge
# Discharge Treatment Plan for Pediatrics

## Medications

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
</table>
| A. **β-agonists** | 1. Regular use often required for 48 hours.  
2. PRN use after 48 hours if symptoms controlled.  
3. If unable to control systems with β-agonists return to ED or see a physician. |
| B. **Corticosteroids** | 1. Oral indicated for most patients.  
2. Prednisone: 1-2 mg/kg/day for 7 days as non-tapered dose.  
3. Individual plans based on past treatment/recent symptoms.  
4. Inhaled corticosteroids should be continued (even if taking prednisone) and reviewed with family physician.  
5. May need increased dose of inhaled corticosteroids after prednisone. Consider inhaled corticosteroids as integral part of long term management. |
| C. **Other medications** | 1. To be continued on discharge.  
2. Role in long term management to be assessed by primary care provider or consultant. |
| D. **Antibiotics** | 1. Antibiotics are not first line treatment and should be reserved for patients that fail to respond to aggressive anti-inflammatory therapy. |

## Patient Instructions

### Review

1. Drug delivery technique, role, dosing and schedule (puffer, spacer device, powder delivery).  
2. Role of relievers (β-agonists) and preventers (anti-inflammatory).  
3. Role of trigger avoidance.  

### Explain: when to seek treatment

1. Treatment failure: indications for emergency assessment or physician advice (based on signs, symptoms and medication requirements, e.g., dose [number and frequency of puffs] of β-agonists required for relief or control of symptoms).  
2. Worsening/persisting symptoms, modify dose and schedule of steroid therapy. Follow-up with family physician or consultant in 1-7 days to assess adequacy of treatment response.  

### Educate

1. Provide parent/guardian and/or patient with written instructions at discharge.  
2. Provide with accompanying patient brochure.  
3. When to seek physician advice or return to ED.  

### Follow-up

1. Consider referral to pediatrics, respirology, allergy/immunology, or asthma clinic for high risk patients:  
   - refer to Alberta Asthma Resource Catalogue  
   - refer to the CPG for the diagnosis and management of chronic asthma.  

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