DEPARTMENTS OF PEDIATRICS AND EMERGENCY MEDICINE
COLLEGE OF MEDICINE, KING SAUD UNIVERSITY
CLINICAL PRACTICE GUIDELINE
HOSPITAL MANAGEMENT OF ACUTE ASTHMA EXACERBATION

THIS GUIDELINE PROVIDES EVIDENCE BASED RECOMMENDATIONS ON THE DIAGNOSIS, ASSESSMENT AND MANAGEMENT FOR CHILDREN WITH ACUTE ASTHMA PRESENTING TO KING KHALID UNIVERSITY HOSPITAL .

INTRODUCTION

Acute asthma exacerbation is the leading cause of admission of the children to King Khalid University Hospital. A clear guideline and pathway is essential for early and successful management of this condition. There are many guidelines currently available nationally and internationally. After reviewing these guidelines (UK-BTS/SIGN, GINA, NIH – USA, National Asthma Council – Australia, SINA and National Saudi Protocol), it was decided to adapt the SIGN/BTS guidelines as these seemed very robust and clear and most up to date. Although this is based on the SIGN/BTS guideline, the nursing and medical roles are adapted from Asthma guidelines of Princess Margaret Hospital for Children ,Perth Australia. Also included in the algorithm is the validated PRAM score which is not a part of the BTS/SIGN guideline

SCOPE AND PURPOSE

Children under 13 presenting to King Khalid University Hospital with acute severe asthma will be managed according to this guideline. This guideline provides evidence-based recommendations for diagnosis, assessment and management of acute asthma in children. This does not address the long term management of asthma in children.

STAKEHOLDER INVOLVEMENT

The guideline is based on the British Thoracic Society /SIGN guideline for management of Acute asthma. It is adapted and reviewed by all parties (Paediatric Pulmonology. Paediatric Allergy/Immunology, ER and PICU, Clinical Pharmacist and Head Nurses) involved in the management of children with Acute Severe Asthma in King Khalid University Hospital.

PLAN OF ACTION

Implementation of these guidelines will be supervised by senior Pediatricians (Consultants, Senior Registrars and Registrars) in ER , PICU and Ward.
Audits will be designed to monitor, assess and measure implementation and deviation from these guidelines.
These clinical guidelines will be reviewed after one year of implementation. (October 2011)

The following groups of children may need different management & need to be discussed with on call Consultant in Pediatric Pulmonology /Allergy & Immunology

- *Children who are admitted to PICU with life-threatening asthma,*
- *Infants under 6 months of age.*

DIAGNOSIS

Asthma can rarely be confidently diagnosed in children less than 1 year of age.
Diagnosing asthma even in older children can sometimes be difficult. One may need a therapeutic asthma treatment trial for supporting the diagnosis. The label of asthma should not be applied inappropriately during the trial. In most cases the diagnosis of asthma in young children is made on an assessment of symptoms and clinical finding. It is important to record the reasons by which the diagnosis is formed. It may be supported as many of the following features as possible:

D

Episodes of Wheeze: *Clarify what the parents mean by wheeze. Only characteristic expiratory noise should be considered***.** The first episode of wheeze in children under 2 can be difficult to distinguish from acute bronchiolitis or viral bronchitis**.** Asthma is a possible diagnosis if the episodes occurring in children more than 2 years of age have multiple triggers and also if the child is symptomatic in the interval period .

Coexistence of atopic disease

A history of eczema / rhinitis/rhinosinusitis/ allergies/urticaria increases the probability of asthma. Positive tests for atopy in a wheezing child also increase the likelihood of asthma. A raised specific IgE to wheat, egg white, or inhalant allergens such as house dust mite and cat dander, predicts later childhood asthma. First-degree relatives with asthma or atopic disease (especially maternal)
2++

Markers of allergic disease at presentation

Positive skin prick tests, RAST and raised eosinophil count peripherally and in lavage are possibly related to severity and childhood persistence of asthma

Family history of atopy

A family history of atopy is the most clearly defined risk factor for atopy and asthma in children. The strongest association is with maternal atopy, which is an important risk factor for the childhood onset of asthma and for recurrent wheezing that persists throughout childhood.
2++

Common Triggers

Upper respiratory tract infections /Allergen exposure/Exercise/Exposure to cold air

Lung function:

Bronchoconstriction – brought on by exercise (Wheeze/Chest tightness/ Shortness of breath)
Reversibility –Response to bronchodilator—Change in Spirometry by +12% in children who are able to do lung function or disappearance of Wheeze in those unable.
Variability (PEFR)
Persistent reductions in baseline airway function and increased airway responsiveness during childhood are associated with having asthma in adult life 3

Presence of at least 2 Clinical Features

Wheeze/ Shortness of breath/ Chest tightness / Cough

Physical signs of airway obstruction In the acute setting, these include tachypnoea recession use of accessory muscle**,** hyperinflation, and prolonged expiration

CONSIDER DIAGNSOSIS OTHER THAN ASTHMA

Cough alone in the absence of wheeze ± chest tightness ± shortness of breath is NOT ASTHMA
One can encounter children who are “happy wheezer’s” due to small airway caliber in the setting of viral LRTI and they may be labeled as having hyperactive airways and not necessarily asthma.

NON-ASTHMATIC CAUSES OF WHEEZE IN YOUNG CHILDREN

Condition	**Characteristics**
Transient infant wheezing	Onset in infancy, No associated atopy, Association with maternal smoking
Cystic Fibrosis /PCD	Recurrent wheeze, cough, and failure to thrive
Inhaled Foreign Body	Sudden onset localized/focal wheeze
Milk aspiration/cough during feeds	Especially liquids, associated with developmental delay
Structural abnormality (i.e. airway malacia)	Onset at birth
Cardiac Failure	Associated with congenital heart disease
Suppurative lung disease (chronic bronchitis & bronchiectasis)	Presence of an early morning wet/moist cough

MEDICAL HISTORY

Inquire specifically about the following:
Duration and symptoms of current episode
Treatments used (relievers, preventers, complementary therapies used)
Recent changes in treatment and the effect of those changes
Trigger factors (including URTI, allergy, passive smoking)
Frequency, pattern and course of previous acute episodes (e.g. ED visits, hospital or ICU admissions)
Parental understanding of the management of asthma

Presence and frequency of interval symptoms (sleep disturbance due to asthma symptoms, early morning symptoms, exercise-induced cough or wheeze, and frequency of β_2-agonist use)
Atopic disorders
Consider other causes of wheeze (e.g. viral bronchiolitis)

Focus the initial assessment in children suspected of having asthma on:

- Presence of key features in the history and examination
- Careful consideration of alternative diagnoses.

B

Record the basis on which a diagnosis of asthma is suspected.

PHYSICAL EXAMINATION
Important parameters in the assessment of the severity of acute childhood asthma are:

ASSESSMENT & MANAGEMENT OF ACUTE ASTHMA IN CHILDREN >2 YEARS OF AGE

NOTE AND RECORD GENERAL APPEARANCE/MENTAL STATE

WORK OF BREATHING (use of accessory muscles /recession/respiratory rate)
Tachypnoea RR> 30/min (>5 years) or >50/min(2-5 years)
Poor respiratory effort is a sign of life threatening asthma

INITIAL ARTERIAL OXYGEN SATURATION ON PRESENTATION
An initial O_2 saturation of < 92% on presentation is a good predictor of the need for hospitalisation. Oxygen therapy in children is recommended if O_2 saturation is < 92%.
*Please note O_2 saturation of > 92% does not exclude deterioration in ventilation (with CO2 retention). Pulse oximetry (SpO_2) **should not be used as the sole indicator** of a child's condition. Assessment of other parameters, such as work of breathing, should form part of the assessment.*

The following signs provide helpful additional information when assessing the severity of acute asthma in children, but are less reliable features:

HEART RATE: Increasing tachycardia generally denotes worsening asthma. See below for heart rates Influenced by respiratory compromise of any cause. Also influenced by systemic effect of bronchodilators as well as anxiety.

ABILITY TO TALK: Usually reduced in severe asthma,
WHEEZE INTENSITY, PULSUS PARADOXUS, AND PEAK EXPIRATORY FLOW RATE ARE NOT RELIABLE IN ASSESSING THE SEVERITY OF ACUTE CHILDHOOD ASTHMA. ASYMMETRY OF BREATH SOUNDS IS OFTEN FOUND IN MUCUS PLUGGING.

TRIAGE AS MILD, MODERATE, SEVERE (± LIFE THREATENING) ASTHMA EXACERBATION USING FOLLOWING MODIFIED PULMONARY SCORE

Score	RR Age< 6 ys *Age> 6 yrs	Wheeze	Recession	Cerebral
0	<30 * <20	None	None	Normal
1	31-45 *21-35	Occasional	IC	Agitated
2	46-60 *36-50	Widespread	IC +SC	Depressed
3	>60 *>50	Audible	IC+SC+ SS	Comatose
Mild <5, Moderate 6-10, Severe >11; IC: Intercostal, SC :Subcostal, SS: Suprasternal				

CHILD WITH ANY OF THE FOLLOWING CLINICAL SIGNS
Silent chest / Cyanosis/ Poor respiratory effort/ Exhaustion/ Hypotension/ Confusion with SpO_2 <92% /PEF <33% best or predicted or PaO_2 < 8 kPa

ALL CHILDREN WITH MODERATE TO SEVERE ASTHMA NEED URGENT SENIOR REVIEW. CONSULTANT NEEDS TO BE INFORMED OF ANY CHILD WITH SEVERE/LIFE THREATENING ASTHMA IMMEDIATELY

MANAGEMENT

TRY TO CALM THE CHILD IF POSSIBLE - AVOID UNNECCESARY IV CANNULATION & INVESTIGATIONS ESPECIALLY IN MILD EXACERBATIONS

1. **Humidified Oxygen** Via face mask if O_2 saturations<92%, or otherwise clinically indicated
2. **SHORT ACTING β2 AGONIST** – (SALBUTAMOL pMDI) INHALED VIA SPACER (PLUS MASK IF LESS THAN 5 YEARS OF AGE)
   GIVE 2- 10 PUFFS INITIALLY IF MILD TO MODERATE ASTHMA OTHER WISE GIVE 10 PUFFS IF SEVERE
   REPEAT DOSES AT 20 TO 30 MINUTES IF SEVERE/LIFE THREATENING OR 2-4 HOURLY IF MODERATE EXACERBATION
   CAN CONTINUE TO USE NEBULISERS AS AN ALTERNATIVE TILL WE HAVE SUPPLY NEEDS ADDRESSED
   Consider switching to nebulised salbutamol and adding Ipratropium (Ipratropium for Severe Exacerbations ONLY)
   If patient unable to cooperate with spacer or is deteriorating despite appropriate use of spacer.
   Nebs driven with O_2 at 8L/min

Dose:	**2-5 years**	>**5 years**
Salbutamol *(Ventolin)- Nebulised*	2.5 mg	5mg
Ipratropium *(Atrovent)- Inhaled(20µgpMDI)*	2 puffs	4 puffs
Ipratropium *(Atrovent)- Nebulised*	125-mcg	250-mcg

3. **STEROIDS (FOR ≥ MODERATE EXACERBATION ONLY)**
   Oral Corticosteroid
   Prednisolone 1-2 mg/kg daily (50mg max.) for 3-5 days
   For those not tolerating oral medication :- IV Hydrocortisone 4mg/kg or IV methylprednisolone 2 mg/kg loading dose followed by 0.5 mg/kg 6 Hourly, until condition improves and able to tolerate oral medication

4. **INVESTIGATIONS**
   DO NOT ORDER CXR OR BLOOD GASES – UNTIL REALLY INDICATED
   SEE BELOW FOR INDICATIONS

ANY CHILD WITH MILD ASTHMA ,WHO RESPONDS TO INHALED SALBUTAMOL & NEEDS IT AT MORE THAN AT 4 HOURLLY INTERVAL CAN BE DISCHARGED HOME.

CRITERIA FOR ADMISSION TO THE WARDS:

- ***ANY CHILD NEEDING SALBUTAMOL AT BETWEEN 2- 4-HOURLY INTERVALS***
- ***PREVIOUS HISTORY OF LIFE THREATENING ASTHMA/PICU ADMISSION (HIGH RISK PATIENTS)***
- ***SOCIAL FACTORS THAT MAY INTERFERE WITH ASTHMA MANAGEMENT***
- ***CHILDREN WITH NO RESPONSE TO INTENSIVE TREATMENT , NEEDING ½ HOURLY TO LESS THAN 2 HOURLY SALBUTAMOL SHOULD BE MANAGED IN ER TILL AVALABILITY OF BED HIGH DEPENDENCE UNIT/PICU***

INPATIENT MANAGEMENT: TREATMENT GOALS:

- Correction of significant hypoxemia with supplemental oxygen: In severe cases, alveolar hypoventilation requires mechanically assisted ventilation.
- Rapid reversal of airflow obstruction by using repeated or continuous administration of an inhaled β_2-agonist:
- Early administration of systemic corticosteroids (e.g. oral prednisone or intravenous methylprednisolone) is suggested in children with asthma that fails to respond promptly and completely to inhaled β_2-agonists.
- Reduction in the likelihood of recurrence of severe airflow obstruction by intensifying therapy: Often, a short course of systemic corticosteroids is helpful.

Select the highest category that matches patients' symptoms to establish severity and treatment required. Modify management as patients' asthma improves, as per guideline below.

Before children can receive appropriate treatment for acute asthma in any setting, it is essential to assess accurately the severity of their symptoms. The following clinical signs should be recorded:
Pulse rate (increasing tachycardia generally denotes worsening asthma; a fall in heart rate in life threatening asthma is a pre-terminal event)
Respiratory rate and degree of breathlessness (i.e. too breathless to complete sentences in one breath or to feed)
Use of accessory muscles of respiration (best noted by palpation of neck muscles)
Amount of wheezing (which might become biphasic or less apparent with increasing airways obstruction)
Degree of agitation and conscious level (always give calm reassurance).
Clinical signs correlate poorly with the severity of airways obstruction.
Some children with acute severe asthma do not appear distressed. 2++

CHILDREN NOT RESPONDING TO STANDARD ASTHMA TREATMENT
Any child on ½ hourly-inhaled β_2 agonist requires medical review every 2 -3 hours. If a child is not responding to ½ hourly inhaled β_2 agonist therapy and oral/IV steroids:

Nursing Staff:
Contact ward medical staff for urgent review. If medical staff unable to attend, Call a CODE, for immediate review by PICU registrar and PICU nurse coordinator.

Medical Staff:
Consider changing to continuous nebulised salbutamol and adding one or both of the treatments described below. The on call consultant must be notified at this stage to discuss treatment options.

SALBUTAMOL:

Continuously Nebulised Salbutamol or Intravenous Salbutamol is a useful adjunct to managing acute severe asthma if instituted early as a bolus of 15 microgram /kg followed by a continuous infusion of 2 micrograms/kg/minute. Care should be taken to monitor Serum Potassium levels
One study has shown that an IV bolus of salbutamol given in addition to near-maximal doses of 1+ nebulised salbutamol results in clinically significant benefits for those with moderate to severe asthma.424
Evidence 1+

Consider early addition of a single bolus dose of intravenous salbutamol (15 mcg/kg over 10 minutes) in severe cases where the patient has not responded to initial inhaled therapy. B

When inserting an IV cannula take a blood sample to measure serum electrolytes. Serum potassium levels are often low after multiple doses of β2 agonists and should be replaced.
PICU team should review all children who need IV Salbutamol for admission

Magnesium Sulphate: The potential benefit of magnesium sulphate during acute asthma may be via smooth muscle relaxation secondary to inhibition of calcium uptake. Several studies have evaluated inhaled and intravenous administration of magnesium sulphate in severe childhood asthma, but results are diverging. A recent meta-analysis, however, suggested that intravenous magnesium sulphate may be effective in children with severe acute asthma, whereas more studies are needed to evaluate the effect of inhaled magnesium sulphate. *The recent GINA-guidelines suggest that intravenous magnesium may be considered in acute moderate and severe asthma with incomplete response to initial treatment during the first 1-2 hours*. It is interesting that this treatment option is listed before intravenous theophylline. The dose of intravenous magnesium sulphate children used in studies is 25 - 100 mg/kg given over 20 minutes Intravenous magnesium sulphate is not studied in young children and is not included in recent guidelines for children younger than five years of age.

Evidence 1+

IV Aminophylline IV aminophylline is a useful alternative to IV Salbutamol in Severe /Life threatening asthma

IMPORTANT:

PICU must review all children who need IV aminophylline. The loading dose can be commenced while waiting PICU review (as long as PICU has been informed).

Serum potassium level must be checked before commencement in case supplemental potassium is required.

If on oral theophylline, ***do not*** give IV aminophylline - take serum level first. Avoid or modify loading dose according to blood levels.

Consider dose reduction in obese patients (consult with pharmacy).

Aminophylline is not recommended in children with mild to moderate acute asthma.

A

Consider aminophylline in a HDU or PICU setting for children with severe or life threatening bronchospasm unresponsive to maximal doses of bronchodilators plus steroids

C

IV Aminophylline regimen: 5mg/kg IV (**maximum dose 500mg**) over 1 hour as loading dose

Response to loading Dose:

Good: Stop infusion after loading dose completed

No Improvement: --**Contact PICU TEAM for review & transfer (to PICU)**

Monitoring a child on IV Aminophylline on the ward:

There must be adequate nursing staff on the ward to allow close monitoring of the patient. The medical team needs to discuss this with the nurse coordinator on the ward.

All children on IV aminophylline must have cardiac monitoring and this is to be commenced as quickly as possible. IV aminophylline can be commenced without a cardiac monitor insitu, as long as arrangements for cardiac monitoring are being made (this may require transfer to another ward or PICU where cardiac monitoring is available). Potential cardiac adverse reactions include tachycardia, extra systoles, atrial and ventricular arrhythmias.

Other potential adverse reactions include nausea and vomiting

Medical staff:

Should remain on the ward during commencement of IV aminophylline to monitor patients' response, and then assess the need for their presence during the infusion. If medical staff makes the decision to leave the area they must be immediately available to review the patient on request of the nursing staff.

Nursing staff:

Should check and record pulse, respirations, and pulse oximetry every 15 minutes for the duration of the loading dose. Inform medical staff immediately of any adverse reactions. Frequency of continuing observations will depend on the child's condition.

Role of Heliox: Heliox is a helium-oxygen (80:20 or 70:30) mixture that may provide dramatic benefit for ED patients with severe exacerbations.

Helium is about 25% as dense as room air and, consequently, it travels more easily down narrowed passages. This property makes Heliox of particular value to patients at risk of intubation—by quickly decreasing the work of breathing and, when the gas mixture is used to drive the nebulizer, by better delivery of the inhaled bronchodilator.

Despite considerable promise, the literature shows mixed results. Potential explanations include the large number of small trials (low statistical power) and suboptimal delivery of salbutamol to the patient. Briefly, heliox-driven nebulizer treatments should have the gas set at a rate of 8-10 L/min and with double the usual amount of salbutamol. These adjustments result in the delivery of the appropriate amount of salbutamol to the patient but with particles being delivered in the heliox mixture instead of oxygen or room air. When patients need supplemental oxygen, one can deliver it via nasal prong. Of course, as the supplemental oxygen is increased, the benefits of using heliox decrease. Oxygen requirements should determine the ideal mix. The role of heliox in acute asthma remains under investigation

Inhaled Ipratropium Bromide *(Atrovent)*

Use of ipratropium with salbutamol for the treatment of moderate-severe paediatric asthma in the ED is supported by studies. There is no evidence supporting its continued use once admitted to the ward. **1+**

Consider inhaled ipratropium bromide in combination with an inhaled β_2 agonist for more severe symptoms. B

Salbutamol & Ipratropium Regimen:

Dose:	Young infants	2-6 years	>6 years
Salbutamol *(Ventolin)*	1.25 mg	2.5 mg	5mg
Ipratropium *(Atrovent)*	125 mcg	125 mcg	250 mcg

- Give continuous nebulised salbutamol driven with oxygen @ 8L/minute
*- Add nebulised ipratropium every 20 minutes for 1 hour then, if needed, give ipratropium 6 hourly

Oxygen: Oxygen must be considered as a drug in a situation of acute asthma, reducing hypoxic pulmonary vasoconstriction and interfering with the ventilation-perfusion mismatch characteristic for severe bronchoconstriction. Oxygen should be delivered to achieve satisfactory oxygen saturation in obstructive children with suspected or verified hypoxia. No controlled studies have evaluated which level of oxygen saturation that is adequate during an acute asthma attack, but recent guidelines recommend that oxygen saturation in children should be kept above 95% . Oxygen may be delivered by a facemask or by nasal cannulae, and the dose should be adjusted by continuous monitoring by pulse oxymetry. Oxygen at a rate of 6-8 litres per minute should be used to deliver nebulised drugs. In severe cases, oxygen should be administered before other drugs and before assessment is completed.

Oral corticosteroids: given daily for 3 days (up to 5 days in severe exacerbations)

IV corticosteroids: for children with severe exacerbations where there may be doubts about the administration, absorption or retention of oral medication. The intravenous route should be considered in any child with an IV in situ.

Short acting β_2-agonists: are given PRN as assessed by nursing staff and according to above guidelines.

Nursing Staff: Frequency of patient observations depend on patients' clinical status. Inform medical staff of clinical deterioration as indicated by one or more of the following:
Increased work of breathing
Increasing β_2-agonist requirement
Decreasing oxygen saturations / increasing oxygen requirement

Medical staff: Should be available to promptly assess patients at the request of nursing staff.

TREATMENT OF ACUTE ASTHMA EXACERBATION IN CHILDREN AGED LESS THAN 2 YEARS

β2-AGONIST BRONCHODILATORS

A trial of bronchodilator therapy should be considered when symptoms are of concern. If inhalers have been successfully administered but there is no response, review the diagnosis and consider the use of other treatment options.

Inhaled β2 agonists are the initial treatment of choice for acute asthma. Close fitting facemasks are essential for optimal drug delivery. The dose received is increased if the child is breathing appropriately and not taking large gasps because of distress and screaming.

There is good evidence that pMDI + spacer is as effective as, if not better than, nebulisers for treating mild to moderate asthma in children aged ≤2 years. 1+

For mild to moderate acute asthma, a pMDi + spacer is the optimal drug delivery device **A**

Whilst β2 agonists offer marginal benefits to children aged <2 years with acute wheeze, there is little evidence for an impact on the need for hospital admission or length of hospital stay. 1+

Oral β2 agonists have not been shown to affect symptom score or length of hospital stay for acute asthma in infancy when compared to placebo. 1+

oral β2 agonists are not recommended for acute asthma in infants. Grade B

STEROID THERAPY

Steroid tablets in conjunction with β2 agonists have been shown to reduce hospital admission rates when used in the emergency department. Steroid tablets have also been shown to reduce 1+ the length of hospital stay.

Consider steroid tablets in infants early in the management of severe episodes of acute asthma in the hospital setting. B

One study has shown similar benefits when comparing oral and nebulised steroids for acute asthma.

Steroid tablet therapy (10 mg of soluble prednisolone for up to three days) is the preferred steroid preparation for use in this age group.

IPRATROPIUM BROMIDE

The addition of ipratropium bromide to β2 agonists for acute severe asthma may lead to some improvement in clinical symptoms and reduce the need for more intensive treatment. It does 1+ not reduce the length of hospital stay either in combination with β2 agonists or in comparison with placebo.

Consider inhaled ipratropium bromide in combination with an inhaled β2 agonist for more severe symptoms.

Grade B

REQUEST REVIEW FOR TRANSFER TO PICU IF CHILD:

- In impending respiratory failure (drowsy or confused, paradoxical thoraco-abdominal movement, absence of wheeze, bradycardia, breathlessness severe enough to preventing feeding) ,
- and/or has required continuous nebulised salbutamol for > 1 hour,
- and/or has required salbutamol more frequently than every 30 minutes for more than 2 hours,
- and/or has not shown any improvement 1 hour after commencement of an IV aminophylline loading dose

Nursing staff: If medical staff unable to attend Call code blue for immediate review by PICU registrar & PICU nurse coordinator.

INVESTIGATIONS

Chest X-rays: Not generally required for the assessment of acute asthma. It may be however required if evidence of a complication (e.g. pneumothorax), not responding to treatment or concerns regarding deterioration. Consider performing CXR in case of first wheezy episode or suspected foreign body

Arterial Blood Gas (ABG): Rarely required in the assessment of acute asthma in children.

Nasopharyngeal Aspirate (NPA):

Only when a specific viral diagnosis needs to be considered and if it will alter management. . Discuss with registrar/consultant if considering.

Spirometry with bronchodilator response:

Spirometry should be routinely performed for children >5 years as part of their Discharge planning and follow-up in order to achieve accurate and objective assessment and management of their asthma. To arrange this, document a request for follow up “with PFT” on the patients’ appointment card and complete a Respiratory Function Request form. book the test with the follow up appointment.

Peak Expiratory Flow (PEF) Readings: The usefulness of peak flow measurements in the initial assessment of acute asthma in children is limited, as they are effort dependent and can give inconsistent and inaccurate results, and so is not recommended.

At home, the regular use of peak flow readings in children is generally not recommended as it is often limited by poor technique, poor compliance, adds little to the recognition of symptoms and may result in inappropriate treatment.
Please note peak flow meters are single patient use items and should not be reprocessed.

CRITERIA FOR DISCHARGE
The patient is medically fit for discharge if respiratory status has improved as evidenced by: no significant audible wheeze with good air entry tolerating 4 hourly bronchodilator via spacer and metered dose inhaler observations within acceptable range (including SpO_2, heart rate, respiratory rate)
All discharge education and planning should be completed prior to discharge

DISCHARGE PLANNING AND EDUCATION
Commences on admission. The following should be completed prior to discharge, and should be completed for all children who present to PMH with acute asthma

MEDICAL
Complete and Explain Asthma Action Plan
Give clear advice regarding ongoing management of the current episode and for future exacerbations. Either use the PMH action plan or a handwritten plan tailored to the child's needs and family's level of understanding. Ideally a copy should be made for the child's medical file and one posted to the child's GP with the child's discharge letter. Symptom based asthma action plans are preferred in children.
*Please note: Doubling the maintenance dose of ICS is **not effective** in managing exacerbations of asthma in children*.

Order Discharge Medications:
Complete oral corticosteroid course.
Consider prescribing and including instructions on action plan to commence oral steroid 1mg/kg at home for up to 3-5 days for acute asthma exacerbations requiring short acting β2 agonist more than 3-4 hourly.
Bronchodilator PRN
Review prophylaxis (see Long Term Control)

Complete discharge letter.

Arrange Follow – Up
Explain and arrange follow up with GP/in OPC/in Consultant Rooms as appropriate.
Parents should be encouraged to seek medical review (preferably from their GP) if no significant improvement within 48 hours of discharge.

Indications for follow up by Paediatric Pulmonologist:
Asthma not controlled by Inhaled Corticosteroids (ICS) in dose of Fluticasone:> 250 microgram/ day (or equivalent).
Atypical or severe asthma
Commencement of preventive treatment during admission
Patients whose treatment required admission to the PICU. Consider referral to respiratory medicine for children who have required repeat admissions to PICU .
Frequent asthma presentations to the ED or hospitalisations for asthma .
Frequent courses of oral corticosteroids
Other medical or psychosocial issues that complicate asthma management

NURSING:
Asthma Educators to Give written asthma information
Demonstrate and check spacer technique, and explain how to wash spacer
Ensure discharge medications given and explained
This Includes spacer device +/- mask for home which can be used by the child during their admission and then taken home on discharge. Spacers are ordered from pharmacy.
Ensure parents are aware of their child's follow-up

Asthma Clinical Practice Guideline Reference List

1. British Thoracic Society & Scottish Intercollegiate Guidelines Network. British Guideline on the Management of Asthma. Thorax 2008;63:1-121.

2. National Asthma Council Australia. Asthma Management Handbook. 2006. Retrieved June 2008 from http://www.nationalasthma.org.au/cms/index.php (Review inc Levels Level I and II)

3. Global Initiative for Asthma (GINA). Global Strategy for Asthma Management and Prevention. Updated 2007. Retrieved February 2008 from http://www.ginasthma.com (Review inc. Levels I and II)

4. Al-Moamary M, Al-Hajjaj M, Idrees M, Zeitouni M, Alanezi M, Al-Jahdal H, et al. The Saudi Initiative for Asthma. *Ann Thorac Med.* 2009;4:216–23.

5. Saudi National asthma management protocol

6. Francine m et al. The *Pediatric* Respiratory Assessment Measure: A Valid Clinical Score for Assessing Acute Asthma Severity from Toddlers to Teenagers *J Pediatr 2008;152:476-80*

APPENDIX 1

KEY TO EVIDENCE STATEMENTS AND GRADES OF RECOMMENDATIONS

LEVELS OF EVIDENCE

1^{++}	High quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias
1^{+}	Well conducted meta-analyses, systematic reviews, or RCTs with a low risk of bias
1 –	Meta-analyses, systematic reviews, or RCTs with a high risk of bias
2^{++}	High quality systematic reviews of case control or cohort studies High quality case control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal
2^{+}	Well conducted case control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal
2	Case control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal
3	Non-analytic studies, eg case reports, case series
4	Expert opinion

GRADES OF RECOMMENDATION

Note: The grade of recommendation relates to the strength of the evidence on which the recommendation is based. It does not reflect the clinical importance of the recommendation.

A	At least one meta-analysis, systematic review, or RCT rated as 1^{++}, and directly applicable to the target population; or A body of evidence consisting principally of studies rated as 1^{+}, directly applicable to the target population, and demonstrating overall consistency of results
B	A body of evidence including studies rated as 2^{++}, directly applicable to the target population, and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 1^{++} or 1^{+}
C	A body of evidence including studies rated as 2^{+}, directly applicable to the target population and demonstrating overall consistency of results; or Extrapolated evidence from studies rated as 2^{++}
D	Evidence level 3 or 4; or Extrapolated evidence from studies rated as 2^{+}

GOOD PRACTICE POINTS

Recommended best practice based on the clinical experience of the guideline development group.

Audit point

DEPARTMENT OF PEDIATRICS & EMERGENCY MEDICINE , KKUH
ACUTE ASTHMA MANAGEMENT IN CHILDREN >2 YEARS OF AGE

DATE OF ADMISSION: __/__/____
TIME OF ADMISSION: __:__
REFERRAL SOURCE :

PATIENT DETAILS

ER Presentation with 2 previous Wheezy episodes or asthma diagnosis

TRIAGE | **TIME:** | **SCORE=**

MILD | **MODERATE** | **SEVERE**

Give oxygen to keep saturations >92%

Oral Prednisolone (IV if vomiting or not tolerating)

Salbutamol Inhaled every 20 minutes 1-2 doses in first Hour

Salbutamol Inhaled & Ipratropium ** Every 20 minutes x 3 doses in the first hour
Give steroid as per doctors orders after first MDI treatment

CONSIDER LIFE THREATENING IF
- **POOR RESPIRATORY EFFORT**
- **SILENT CHEST**
- **AGITATED/ALTERED CONSCIOUSNESS**
- **CYANOSIS**

Score	RR Age< 6 yrs *Age> 6 yrs	Wheeze	Recession	Cerebral
0	<30 *<20	None	None	Normal
1	31-45 *21-35	Occasional	IC	Agitated
2	46-60 *36-50	Widespread	IC +SC	Depressed
3	>60 *>50	Audible	IC+SC+ SS	Comatose

Mild<5, Moderate 6-10, Severe >11;
IC: Intercostal, SC :Subcostal, SS: Suprasternal

Continuous Neb Salbutamol with O2
Ipratropium x3 if not already given
Establish IV
IV Fluids & Methylprednisolone

REASSESS | **TIME:** | **SCORE=**

MILD | **MODERATE** | **SEVERE**

PICU TEAM assessment

Give oxygen to keep saturations >92%

1-2 hourly Salbutamol

Improving

Hourly Salbutamol with reassessment

Improving

Salbutamol every 20 minutes/continuously Until able to tolerate hourly

Improving air entry, Min/no wheeze, no recession,no tachpynoea, O2 sats >95%

REASSESS | **TIME:** | **SCORE=**

MODERATE | **SEVERE**

Observe for 2 hrs Discharge If stable & Not needing salbutamol within 4 hours

At Discharge- Continue Prednisolone for upto 3 days
Review Inhaler technique & need for Preventor therapy

Responding

Yes

Admit to Ward if requiring > 2 Hrly Salbutamol

No

Non-Responding

Arrange PICU Review ±Transfer
Consider CXR & Blood Gases
In child > 5 years of age
Consider IV Salbutamol
Consider IV Magnesium Sulphate Bolus

Medication	Route	< 2 years	2-5 years	5 years
Salbutamol	Inhaled	2-10 puffs initially if moderate asthma otherwise give 10 puffs via spacer (plus mask if less than 5 years)		
Salbutamol	Nebulised	1.25 mg	2.5 mg	5 mg
Salbutamol	Intravenous		15 mcg/kg bolus over 10 minutes followed by continuous infusion 1-5 mcg/kg/min	
Ipratropium	Nebulised	125 micrograms	250 micrograms	250 micrograms
Prednisolone	Oral	10 mg	20 mg OD	30-40 mg OD
Methyl Prednisolone	Intravenous		1 mg/kg Loading dose followed by 0.5 mg/kg 6 hourly	
Hydrocortisone	Intravenous		4 mg/Kg 6 hourly	

MANAGEMENT
Oxygen Saturation in room air: %

OXYGEN (humidified) via face mask if saturations < 92% COMMENCED ____ Litres/min

SALBUTAMOL pMDI + Spacer (+ Mask if less than 5 years of Age) Dosage_____puffs) ☐
Or
Salbutamol _____mg Nebulised

If no / minimal response to first dose of Salbutamol
Then give further Salbutamol (pMDI + Spacer) _____ puffs along with ipratropium 20 micrograms 2- 4 Puffs ☐

Or Nebulised Salbutamol _____mg + Ipratropium Nebulised_____mcg (every 20 minutes x3)

STEROIDS
Oral Prednisolone (if able to tolerate orally) _____mg PO OD ☐
or
IV Hydrocortisone/ methyl Prednisolone (circle choice)_____ mg 6 hourly ☐

Notes:

Investigations
NO role for routine CXR and Blood Gasses

Give Reason if requested:

NAME: PAGER /ID: SIGNATURE :