Guideline for Management of Acute Asthma In Children and Young People

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Guideline History		
Date	**Comments**	**Approved By**
2017	First Version: SPH Asthma Guideline 2017 Dr Fiona MacCarthy	
27.11.21	2017 Version updated and adapted by Dr Ruth Mew to incorporate: Aminophylline infusion (May 2019) Salbutamol infusion (May 2019) Magnesium Sulphate bolus (May 2019) Discharge checklist (May 2019) Asthma action plans (March 2021)	Ratified in Guidelines Meeting 21.02.22
08.07.22	Outdated magnesium infusion table removed by Dr Ruth Mew	
13.12.22	2017 Version amended by Dr Alka Thakur and Dr Temiloluwa Oluokun to incorporate: Dexamethasone instead of prednisolone as oral steroid choice (Dec 2022)	

Introduction:

This guideline is adapted from the previous 2017 version with reference to BTS, NICE and BNF guidance. As per NICE and BTS guidelines, it refers to the management of acute asthma in children and young people 1 -17 years. Please refer to the Bronchiolitis guideline (Intranet, June 2021) for the diagnosis and management of Bronchiolitis in babies and children.

Observation values in this guideline are consistent with NICE and BTS.

Drug doses are as per the BNF.

Ashford and St. Peter's Hospitals NHS Foundation Trust

ACUTE ASTHMA ATTACK in Children 1-17 years

Acute moderate asthma
Able to talk in full sentences

SpO2 ≥92%

PEF ≥50% best or predicted

Heart rate
1-5 years: ≤140/min
>5 years: ≤125/min

Respiratory rate
1-5 years: ≤40/min
>5 years: ≤30/min

- Salbutamol inhaler 4-10 puffs via spacer
- Single dose of oral dexamethasone 0.3mg/kg (max 16mg)
- Alternative: Prednisolone 1-2mg/kg
  <2 years 10mg OD
  2-5 years max 20mg OD
  >5 years max 40mg OD
- Reassess in 15 min

Reassess regularly or before inhalers due

Discharge:
Salbutamol inhaler 4hrly
If Dexamethasone not tolerated, Prednisolone for 3-5 days
Safety net

GP review in 48 hours

Please see discharge checklist

Acute severe asthma
Can't complete sentences or too breathless to talk or feed

SpO2 <92%

PEF 33–50% best or

predicted Heart rate
1-5 years: >140/min
>5 years: >125/min

Respiratory rate
1-5 years: >40/min
>5 years: >30/min

Paediatrician to reassess frequently

- Oxygen (aim SpO2 94- 98%)
- Salbutamol neb, max every 20-30mins
  2.5mg
  (<5yr) 5mg
  (>5yr)
- Ipatropium bromide neb Age <12y 250 mcg
  Age >12 y 500 mcg
- Oral dexamethasone
- If oral steroids not tolerated give IV hydrocortisone 4mg/kg
  <2yr max 25mg 6hly
  2-5 yr max 50mg 6 hourly 5-18 yr max 100mg 6hrly

Admit if SpO2 <92% after initial bronchodilator therapy

Oxygen to achieve SpO2 94-98% Salbutamol neb/inhaler 1-2hrly Ipatropium neb/inh 4-6 hrly Steroids oral/iv
Monitor fluid intake
Consider blood gases & bloods (Lact, K+, Glucose)

Life threatening asthma

- SpO2 <92%
- PEF <33% best or predicted
- Exhaustion
- Hypotension
- Cyanosis
- Silent chest
- Poor respiratory effort
- Confusion

Fast bleep Paediatric Team/Anesthetist

- Oxygen (aim SpO2 94-98%)
- Salbutamol
  neb 2.5mg
  <5 y 5mg
  >5 y
- Ipatropium bromide
  neb 250mcg <12y
  500 mcg >12y
  Repeat every 30mins in first 2hrs
- IV Hydrocortisone (see severe)
- IV MgSO4 40mg/kg over 30min (max 2g)
- IV Salbutamol bolus (over 10mins)
  <2 yrs 5mcg/kg
  >2 yrs 15mcg/kg
  (max250mcg)
- IV Salbutamol infusion 1- 2mcg/kg/min
- IV Fluids 2/3rd or full maintenance
- Continuous monitoring
- Do not leave the child

Arrange HDU/PICU
Inform consultant Anaesthetic team
review STRS referral
Consider CXR
Blood gases & bloods (Lact, K+, Glucose)
Further IV MgSO4
Consider Aminophylline infusion

Mild to moderate acute asthma

- MDI and spacer is the preferred option in CYP with mild to moderate acute asthma
- Atrovent inhalers are not usually required for mild to moderate asthma. If indicated doses are:
- **Atrovent inhaler 20mcg/dose: <5years 20mcg (1 puff) TDS >6years 40mcg (2 puffs) TDS**
- Aminophylline is not recommended in children with mild to moderate acute asthma
- Give oral dexamethasone early. A 3-5 day course of prednisolone can be used as an alternative if required.
- For most CYP, a single dose of dexamethasone is sufficient and as effective as a three-day course of prednisolone. Occasionally, a 3 day course may be needed.
- Studies have also shown that dexamethasone is more palatable than prednisolone in CYP with asthma.

Acute Severe Asthma and Life Threatening Asthma
FIRST LINE (inhaled therapy) as per flow chart above

- Oxygen via a tight fitting face mask or nasal cannula to achieve SpO2 94- 98%
- Nebulised Salbutamol
- If symptoms are refractory to initial inhaled Salbutamol treatment, add nebulised Ipatropium bromide. Nebulised Ipratropium bromide is indicated for acute severe asthma and life threatening asthma. The combination of Ipratropium bromide with Salbutamol may lead to greater bronchodilation than using either agent alone
  Nebulised solution <12years 250mcg every 20-30mins for first 2hours then 250mcg 4-6hrly
  Nebulised solution >12years 500mcg
- Repeat the dose of dexamethasone in CYP who vomit and consider intravenous steroids in CYP who are unable to retain orally ingested medication
- Nebulised Magnesium Sulfate is currently an unlicensed use

Clinical signs correlate poorly with the severity of airways obstruction. Some CYP with acute asthma do not appear distressed.

Consider a **CXR** if there is a poor response to treatment. Poor response to treatment may be due to lung collapse, associated chest infection, pneumothorax or dehydration.

If the patient **does not respond to inhaled therapy**, second line management (intravenous treatment) can be started. The consultant should be notified.

SECOND LINE (IV Therapy) as per flow chart above

- ## Intravenous Magnesium Sulfate

In CYP who respond poorly to first-line treatments, consider the addition of IV MgSO4 as a first line intravenous treatment. MgSO4 may help with mucus plug lysis.

IV MgSO4 dose Single dose 40mg/kg administered over 20-30 minutes Maximum dose 2g

Ensure patient is on cardiac monitor before administrating. Side effect hypotension - monitor BP

If there is a positive response, a second dose can be given after 1-2hrs. Discuss with the consultant and check serum calcium and magnesium levels before giving.

- ## Intravenous Salbutamol Bolus

Consider early addition of a single bolus IV salbutamol.

Avoid nebulised salbutamol and IV salbutamol due to risk of tachycardia. ECG monitoring is mandatory for children on IV salbutamol.

IV salbutamol bolus dose Single bolus administered over 10 minutes

Child >2 years 15mcg/kg **Child < 2years** 5mcg/kg Maximum dose 250mcg

SALBUTAMOL BOLUS :

Salbutamol bolus 15micrograms/kg

(5 micrograms/kg if <2 years) Max dose 250 micrograms

500mcg Salbutamol in 10ml Normal Saline 0.9% (50microgram/ml) bolus over 5 min (Use Vial 1ml amp 500mcg/ml= 1Vial)		
Age	Dose in micrograms (A)	Millilitres (divide micrograms by 50)(A÷50)
Under 2 years 5 x weight in kg_____ =	_____ micrograms	_____millilitres
Over 2 years 15 x weight in kg_____ = Max dose 250 micrograms	_____micrograms	_____millilitres

- ## Intravenous Salbutamol Infusion

Continuous intravenous infusion of salbutamol, with continuous ECG and electrolyte monitoring (monitor for hypokalemia), should be considered in children with unreliable inhalation or severe refractory asthma. It is usually commenced in preference to Aminophylline at ASPH. Aminophylline can be used instead of Salbutamol if there are signs of salbutamol toxicity.

Side effects of agitation, tachycardia, lactic acidosis, hypokalaemia increase with dose > 1mcg/kg/min OR additional nebulised salbutamol. Lactic acidosis worsens respiratory function.

IV Salbutamol Infusion dose 1mcg/kg/min

Maximum dose recommended by STRS is 20micrograms/min

SALBUTAMOL INFUSION

10mg of Salbutamol in 50 ml of Sodium Chloride 0.9% (1ml=200mcg) To run at 1mcg/kg/min (Use Vial 5ml amp 1mg/ml : 2 Vials is 10mg)	
Calculation Step 1) **Rate per hour** 1 mcg/kg/min=60 mcg/kg/hr (60 x weight in kg)= **A**	_____micrograms per hour Answer equals **A**
Calculation Step 2) **Rate of infusion** **Rate per hour ÷ 200** **(A ÷ 200)**	_____millilitres per hour (1mcg/kg/min)

Step 1 10mg salbutamol and make up to 50ml with normal saline (200mcg/ml)

Step 2 Calculate dose in mcg per hour

Step 3 Dividing this dose by 200 gives the amount of ml required per hour

Example: *A 45kg boy needs IV salbutamol starting at 1mcg/kg/min: Step 1 10mg make up to 50ml with normal saline (1ml=200mcg), Step 2 1mcg/kg/min= 60mcg/kg/hr so for 45kg child =2700mcg/hr, Step 3 Rate of infusion=2700/200 = 13.5ml/hr*

Please see APPENDIX A for patient notes copy.

- ## Intravenous Aminophylline

Consider aminophylline for CYP with severe or life-threatening asthma unresponsive to other treatments. Aminophylline has a narrow therapeutic range and side effects are common. Inform consultant regarding use. Intravenous Salbutamol is usually commenced in preference to intravenous Aminophylline at ASPH. Aminophylline can be used instead of Salbutamol if there are signs of salbutamol toxicity.

- Continuous ECG monitoring is mandatory. Cardiac arrhythmias can occur.
- Monitor blood pressure. Hypotension can occur.
- Always run with maintenance fluids containing potassium. Monitor U&E 4-6hrly
- Monitor neurological status. Convulsions and headache can occur
- Monitor Aminophylline levels 4-6hrly. Optimal plasma-theophylline concentration for response in asthma 10-20mg/L

IV Aminophylline Loading Dose (not previously treated with theophylline)

5mg/kg administered over at least 20minutes Maximum dose 500mg

IV Aminophylline Infusion Dose (adjusted according to plasma-theophylline concentration)

<12years 1 mg/kg/hr

>12 years 500mcg - 700mcg/kg/hr

Dilute aminophylline to 1mg/ml with 0.9% saline or 5% Dextrose

Run at: < 12 years 1 ml/kg/hr 12-18 years 0.5 - 0.7 ml/kg/hr

Weight (kg)	Rate 500mcg/kg/hr (ml/hr)	Rate 1 mg/kg/hr (ml/hr)
1	0.5	1
2	1.0	2
3	1.5	3
4	2	4
5	2.5	5
6	3	6
7	3.5	7
8	4	8
9	4.5	9
10	5	10
20	10	20
30	15	30
40	20	40

Discontinuing Intravenous Treatments:

CYP who meet the following criteria and have responded to intravenous treatments can be stepped down to bronchodilator therapy.

- Able to talk normally
- Normal respiratory effort
- Reduced oxygen requirement

CYP should receive inhaled or nebulised salbutamol every 2 hours and nebulised ipratropium every 4 hours whilst weaning off intravenous bronchodilators.

Rebound bronchospasm can occur 24-48hours after stopping intravenous bronchodilators. CYP should be observed in hospital for 24-48hours after stopping intravenous treatment.

Aminophylline infusion

Elimination half-life of aminophylline is 3-5 hours. Reduce the intravenous aminophylline dose by 50% of the original dose every 6 hours. Following cessation of infusion, aminophylline will be cleared within 72 hours.

Salbutamol infusion

Elimination half-life of salbutamol is 4-6 hours. Reduce the infusion dose by 50% of the original dose (or by 1mcg/kg/min if the rate is greater than 1mcg/kg/min) every 6 hours. Following cessation of infusion, salbutamol will be cleared within 48 hours.

DISCHARGE PLANNING AND FOLLOW UP as per flow chart above

Children can be discharged home when stable on Salbutamol inhaler 4 hourly that can be continued at home and Peak flow (PEF) is >75% of best or predicted and SpO_2 >94%.

Discharge Checklist

Confirm correct inhaler technique and correct spacer device. All CYP should use a spacer unless prescribed dry powder inhalers (Printed information in Appendix B)

Explain bronchodilator use. Bronchodilators should be used as required, no more frequently than 4 hourly. It is not necessary to provide a Salbutamol weaning plan. Patients should expect that the requirement for Salbutamol to reduce and if this does not happen by 48hrs, a medical review is required.

Provide safety net advice; CYP with worsening symptoms or requiring salbutamol more frequently than 4 hourly should attend A&E for review.

Provide a written Asthma UK asthma plan:

- <12yrs my-asthma-plan-2021-v5-multi-media-live.pdf
- >12yrs asthma-action-plan-adult-2021.pdf

All children should have a Primary Care review in 48 hours (GP or Primary Care asthma nurse).

Follow up in attending consultant clinic within 1-2 months with an additional referral to Respiratory Clinic (RMRSAH) if life threatening asthma.

References:

BTS/SIGN British Guideline on the Management of Asthma 2019

NICE/BNF Asthma, acute | Treatment summary | BNF content published by NICE

STRS Clinical Guideline: Paediatric Critical care: Severe Asthma
https://www.evelinalondon.nhs.uk/resources/our-services/hospital/south-thames-retrieval-service/asthma-may-2018.pdf

Craig SS, Dalziel SR, Powell CV, Graudins A, Babl FE, Lunny C. Interventions for escalation of therapy for acute exacerbations of asthma in children: an overview of Cochrane Reviews. Cochrane Database of Systematic Reviews. 2020(8).

Wei J, Lu Y, Han F, Zhang J, Liu L, Chen Q. Oral dexamethasone vs. oral prednisone for children with acute asthma exacerbations: A systematic review and meta-analysis. Frontiers in Paediatrics. 2019;7.

Shefrin AE, Goldman RD. Use of dexamethasone and prednisone in acute asthma exacerbations in paediatric patients. Can Fam Physician. 2009 Jul

Elkharwili DA, Ibrahim OM, Elazab GA, Elrifaey SM. Two regimens of dexamethasone versus prednisolone for acute exacerbations in asthmatic Egyptian children. Eur J Hosp Pharm. 2020 May

Appendix A: Salbutamol bolus and infusion calculator. Please print and include in patient's notes.
http://trustweb.asph.nhs.uk/docsdata/paed/Guidelines_Paediatrics/Asthma/Salbutamol%20May%202019.pptx

SALBUTAMOL BOLUS :

Salbutamol bolus 15micrograms/kg
(5 micrograms/kg if <2 years) Max dose 250 micrograms

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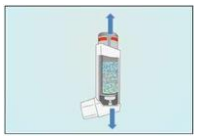
Calculation Step 2) **Rate of infusion** **Rate per hour ÷ 200** **(A** ÷ 200)	_____millilitres per hour (1mcg/kg/min)
Doctor Print	Signed Date/ Time

Appendix B: Inhaler technique leaflet

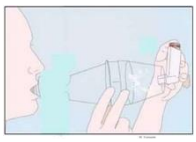
Inhaler technique



Shake

Shake vigorously to mix the medication with other inactive ingredients and aerosol. Failure to do this can result in unreliable delivery of the medication.

The inhaler should be shaken between every dose.

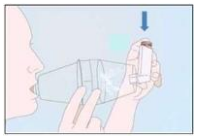


Insert

Insert inhaler into the spacer (depending on your child's age may be a **mask** or **mouthpiece**)

Good seal

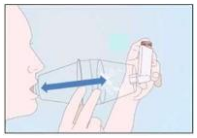
Place the mask over your child's mouth and nose, making a good seal. Try to reassure your child as they may get upset. If they are old enough, place the mouthpiece between their teeth and close the lips tightly around the mouthpiece, keeping their tongue out of the way. Hold spacer against the face straight or tilt slightly upwards.



Press down

Press down the inhaler firmly to release the whole dose.

Deliver ONE dose at a time

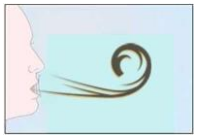


Breath for 10 clicks

To ensure that the whole dose has been received, listen for TEN clicks in the spacer. One click equals one full breath. If no clicks can be heard, check that there is a good seal around the face or reposition the child until a click can be heard.

Remove

Remove the Spacer from your child's face and allow to breath normally again.



Breath and Repeat

After your child has established a normal pattern of breathing again, the process should be repeated if necessary or as prescribed. Always shake the inhaler in between every dose.