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Use of Continuous Albuterol in a Pathway for Treatment of Pediatric Acute Asthma Exacerbation

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Introduction

- The use of RT-driven protocols allows for standardization and improves quality of care.
- At our institution, inpatient treatment of acute asthma in children ≥ 2 years is managed with a score-based pathway that uses a modified Pediatric Asthma Score (PAS).*
- The pathway is RT-driven and provides score-based guidance for initiation and discontinuation of continuous albuterol (CA).
- PAS reassessed every 2 hours while receiving CA.

* Qureshi et. al. N Engl J Med 1998

Pediatric Asthma Score

Asthma Severity	Normal	Mild	Moderate	Severe
PAS	0-4	5-7	8-11	12-15
Scoring Factors	0	1	2	3
Respiratory Rate				
2-3 years	18-26	27-34	35-39	≥40
4-5 years	16-24	25-30	31-35	≥36
6-12 years	14-20	21-26	27-30	≥31
> 12 years	12-18	19-23	24-27	≥28
SpO₂	>98% on room air	95-97% on room air	90-94% on room air	< 90% on room air or on oxygen
Auscultation	Normal breath sounds with good aeration throughout	End-expiratory wheezing only	Expiratory wheezing	Inspiratory and expiratory wheezing to diminished breath sounds
Retractions	None	Intercostal	Intercostal and substernal	Intercostal, substernal and supraclavicular
Dyspnea	Speaks in complete sentences	Speaks in short sentences	Speaks in partial sentences, short cry	Speaks in single words. Short phrases/grunting

Asthma Pathway

ED Management

PAS 8-11

(Moderate exacerbation)

- Albuterol + atrovent nebulized x 3 doses Q20 minutes - OR -
- Continuous albuterol 10-30mg ± atrovent 1.5mg/hr X1hr

Consider:

Magnesium IV 50-75 mg/kg (max 2 g) x 1
Normal Saline (NS) bolus IV fluids

PAS 12-15

(Severe exacerbation)

- Continuous albuterol 10-30mg/hr X1hr ± atrovent 1.5mg/hr

Consider:

Magnesium IV 50-75mg/kg (max 2 g) X1 (give over 20 minutes)
SQ epinephrine 0.01mg/kg (max 0.5mg) X1
SQ terbutaline 0.01mg/kg (max 0.5mg) X1
Inhaled racemic epinephrine
Increase albuterol dose
NIPPV/BiPAP
Normal Saline (NS) bolus IV fluids

General Pediatrics or Pulmonary

PHASE IV (IMU)

- Continuous albuterol 10-30mg/hr

Q2hr assessment

Provide IVF with 40meq KCl
Q8hrs K+ lab

Transfer to CCM if PAS 14-15 or requiring continuous albuterol for >12hrs

Continue PHASE IV if PAS 12-13
Advance to PHASE V after 4hrs of treatment if PAS 0-11 and consider transfer to floor

PHASE V (Floor)

Albuterol MDI 4-8 puffs/Nebulized 2.5-5mg Q2 x2
PRN albuterol for PAS > 4

Q2hr assessments

Provide IVFs with 20meq KCl

Step back to PHASE IV if PAS ≥ 11, transfer to IMU, and consider CCM consult
Advance to PHASE VI after 4hrs if PAS <11

Critical Care Medicine

PHASE I (PICU)

- Continuous albuterol 10-30mg/hr
- AND:
(any of the following)
Magnesium IV 50-75mg/kg (max 2 grams)
SQ epinephrine 0.01mg/kg (max 0.5mg)
SQ terbutaline 0.01mg/kg (max 0.5mg)
Inhaled epinephrine
Increase albuterol dose
NIPPV/BiPAP
Intubation

Q1-2hr assessment

Provide IVF with 40meq KCl
Q8hrs K+ lab

Continue PHASE I if PAS >11
Advance to PHASE II after 2hrs of treatment if PAS 0-11

PHASE II (PICU/IMU)

- Continuous albuterol 10-30mg/hr

Q2hr assessment

Provide IVF with 40meq KCl
Q8hrs K+ lab

Step back to PHASE I if PAS 14-15
Continue PHASE II if PAS 12-13
Advance to PHASE III after 4hrs of treatment if PAS 0-11

PHASE III (PICU/IMU)

- Albuterol MDI 4-8 puffs/Nebulized 2.5-5mg Q2 x2

Q2hr assessments

Provide IVFs with 20meq KCl

Step back to PHASE II if PAS ≥ 11
Transfer to PHASE V Pulmonary after 4hrs if PAS <11

Introduction

- A large volume nebulizer (LVN) is used to administer CA unless receiving additional respiratory support.
- A vibrating mesh nebulizer (VMN) is used to deliver CA while receiving respiratory support such as high flow nasal cannula (HFNC) or non-invasive ventilation (NIV).
- CA use was evaluated during asthma exacerbation treatment with the asthma pathway as part of a quality improvement process.

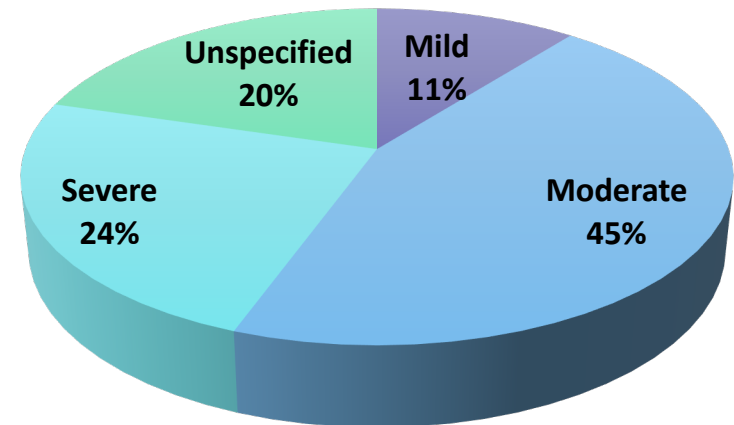
Methods

- Inclusion criteria:
 - Children ≥ 2 years of age admitted for acute asthma 11/2017–12/2019
 - Admitted to PICU or step-down unit
 - Received CA as part of asthma pathway
- Subsequent admissions excluded
- Data collected retrospectively:
 - Subject demographics
 - Asthma classification
 - CA dose / duration
 - Nebulizer type
 - PAS
 - Respiratory support during CA
 - Prescribed inhaled corticosteroid (ICS)
 - Length of stay
 - Readmissions or ED visits within 30 days of discharge
- Descriptive statistics

Results

Subject Characteristics	
Overall	412 children Median age 6 (IQR 4-10) years 71% admitted from ED to step-down
Sex n (%)	Female 161 (39) Male 251 (61)
Race n (%)	Black 247 (60) White 119 (29) Asian 2 (<1) Pacific Islander 2 (<1) Other 42 (10)
Ethnicity n (%)	Not Hispanic 382 (93) Hispanic 28 (7) Unknown 2 (<1)

Asthma Classification

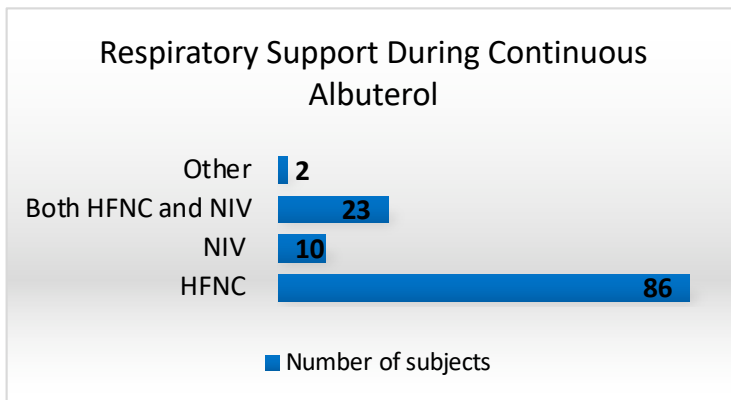


- Median initial CA dose 15 (IQR 10-20) mg/hr
- Median time on CA 560 (IQR 355– 998) min
- LVN 71%, VMN 14%

Results

PAS timing	PAS Median (IQR 25-75)	Missing PAS n (%)
Before CA	11 (IQR 10-12)	66 (16)
During CA	11 (IQR 9-12)	8 (2)
After CA	6 (IQR 5-8)	9 (2)

- 121 (29%) children required respiratory support
- CA restarted in 12 (3%) subjects
- 7 (2%) required transfer to PICU
- No pneumothoraces or deaths
- 202 (49%) prescribed ICS prior to admit
- Median LOS 1.4 (IQR 0.8-2.3) days
- 16 (4%) ED visits and 3 (<1%) readmissions within 30 days of discharge



Discussion

- Asthma protocols can improve patient outcomes and increase adherence to treatment guidelines.^{1,2}
- PAS utilization is a common practice with asthma management protocols.^{3,4}
- CA is generally safe and well tolerated.⁵
- Limitations:
 - Retrospective study
 - Missing PAS documentation
 - Prescribed ICS - did not evaluate adherence

1. Kucher et al Respir Care 2021
2. Miller et al Respir Care 2015
3. Gorelick et al Acad Emerg Med 2004
4. Arnold et al Am Allergy Asthma Immunol 2011
5. Camargo et al Cochran Sys Review 2003

Conclusions

- The use of a RT-driven, score-based pathway for initiation and discontinuation of CA for treatment of pediatric asthma exacerbation was safe with low complication rates.
- Readmissions or ED visits within 30 days of discharge were infrequent.
- Efforts towards increasing documentation before starting CA are warranted.