

MEDIC Guidelines to Reduce Low-Value CXRs in Children with Asthma, Croup, or Bronchiolitis

Supplemental Material

What is MEDIC?

- The [Michigan Emergency Department Improvement Collaborative \(MEDIC\)](#) was launched in 2015 as an emergency physician-led quality improvement Collaborative comprised of hospitals across Michigan.
- MEDIC partners with emergency physicians who work together to collect and analyze data, identify best practices based on medical evidence, and improve collective performance.
- Participating EDs submit data to a clinical registry maintained by the MEDIC Coordinating Center.
- Support for MEDIC is provided by Blue Cross Blue Shield of Michigan and Blue Care Network within the [BCBSM Value Partnerships](#) program.

Why Promote ED Guidelines to Reduce Low-Value CXRs in Children with Asthma, Bronchiolitis, & Croup?

- Most children with asthma, croup, or bronchiolitis do not benefit from CXR
 - *AAP & Society for Hospital Medicine discourage routine CXRs in these children*
 - *Overuse leads to excess cost, radiation exposure, & overtreatment with antibiotics*
- Varied experience with & approaches to the care of children
 - *Can result in a lack of standardized approach to care within & between hospitals*
- Literature-based clinical features can help identify when CXR is low value
 - *Symptoms are regularly encountered in the ED & can overlap with pneumonia*
 - *Guidelines may alleviate concerns about missing clinically-significant pneumonia*

What are these guidelines?

- Consensus-driven
- Supported by thoughtful review of evidence
- **Developed for PEM/ED clinicians by:**
 - Practicing ED physicians
 - From multiple health systems
 - Across the state of Michigan
- To optimize ED use of CXR in children with respiratory illness
- Endorsed by MEDIC

ASTHMA

Clinical considerations for CXR
in children 2yr—17yr with known/suspected asthma.

IF NONE of these are present, question your reason for a CXR.

<ul style="list-style-type: none">• Fever (≥38°C [100°F]) for ≥2 hrs• Tachypnea (≥20/min), diminished breath sounds, hyperinflation or wheezing• Poor lung exam findings (decreased breath sounds, hyperinflation) or wheezing• Chest x-ray findings• Oxygen• Worsening respiratory distress to muscle use, nasal flaring, head bobbing, severe retractions after standard asthma treatment in ED including:<ul style="list-style-type: none">• 3 treatments with inhaled beta agonist + steroid• Requiring escalation of care:<ul style="list-style-type: none">• Continuous inhaled corticosteroid, magnesium, ketamine, nebulator• Supplemental oxygen to maintain saturations >92%	<ul style="list-style-type: none">• Central (pink) &/or neurovascular disease• Pneumothorax (>2nd rib/generations)• Bronchopulmonary dysplasia• Tracheostomy• Cystic fibrosis• Oligo/bronchiectasis• Congenital heart disease
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Presence of one or more of these does NOT automatically require a CXR.

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BRONCHIOLITIS

Clinical considerations for CXR
in children 2mo—2yr with history & exam consistent with bronchiolitis.

IF NONE of these are present, question your reason for a CXR.

<ul style="list-style-type: none">• Fever (≥38°C [100°F]) for ≥2 hrs• Tachypnea (≥20/min), diminished breath sounds, or rales• Poor lung exam findings (decreased breath sounds, hyperinflation) or wheezing• Chest x-ray findings• Oxygen• Worsening respiratory distress to muscle use, nasal flaring, head bobbing, severe retractions• Requiring escalation of care:<ul style="list-style-type: none">• High flow oxygen• CPAP, BIPAP• Intubation	<ul style="list-style-type: none">• Central (pink) &/or neurovascular disease• Pneumothorax (>2nd rib/generations)• Bronchopulmonary dysplasia• Tracheostomy• Cystic fibrosis• Oligo/bronchiectasis• Congenital heart disease• Sickle cell disease• Immunodeficiency
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Presence of one or more of these does NOT automatically require a CXR.

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CROUP


Clinical considerations for CXR
in children 6mo—3yr with history & exam consistent with croup.

IF NONE of these are present, question your reason for a CXR.


<ul style="list-style-type: none">• Suspended foreign body (egestion or choking episode in past 2 hrs)• Fever (≥38°C [100°F]) for ≥2 hrs• Tachypnea (≥20/min), diminished breath sounds, or rales• Poor lung exam findings (decreased breath sounds, hyperinflation) or wheezing• Worsening respiratory distress to muscle use, nasal flaring, head bobbing, severe retractions after standard croup treatment in ED including:<ul style="list-style-type: none">• Steroids• Racemic epinephrine• Requiring escalation of care:<ul style="list-style-type: none">• 32 doses of racemic epinephrine• Supplemental oxygen to maintain saturations >92%	<ul style="list-style-type: none">• Central (pink) &/or neurovascular disease• Pneumothorax (>2nd rib/generations)• Bronchopulmonary dysplasia• Tracheostomy• Cystic fibrosis• Oligo/bronchiectasis• Congenital heart disease• Sickle cell disease• Immunodeficiency• Cancer• HIV/AIDS• Transplant
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Presence of one or more of these does NOT automatically require a CXR.

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Feedback Survey



The Guidelines: *One-pagers with links for feedback*

ASTHMA

Clinical considerations for CXR

in children 2yr—17yr with known/suspected asthma.

If **NONE** of these are present, question your reason for a CXR.

- | | |
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| <ul style="list-style-type: none"> <input type="checkbox"/> Fever $\geq 38^{\circ}\text{C}$ (100°F) for ≥ 72 hrs <input type="checkbox"/> Toxic, ill appearance, somnolent, lethargic, or listless <input type="checkbox"/> Focal lung exam findings (decreased breath sounds, rales, rhonchi) or crepitus <input type="checkbox"/> First wheezing episode <input type="checkbox"/> Chest pain <input type="checkbox"/> Worsening accessory muscle use, nasal flaring, head bobbing, severe retractions after standard asthma treatment in ED including: <ul style="list-style-type: none"> <input type="checkbox"/> 3 treatments with inhaled beta agonist + steroids <input type="checkbox"/> Requiring escalation of care: <ul style="list-style-type: none"> <input type="checkbox"/> Continuous albuterol, magnesium, epinephrine, terbutaline <input type="checkbox"/> Supplemental oxygen to maintain saturations $>92\%$ | <p style="text-align: center;">Comorbidities</p> <ul style="list-style-type: none"> <input type="checkbox"/> Cerebral palsy &/or neuromuscular disease <input type="checkbox"/> Prematurity (<37 wks gestation) <input type="checkbox"/> Bronchopulmonary dysplasia <input type="checkbox"/> Tracheostomy <input type="checkbox"/> Cystic fibrosis <input type="checkbox"/> Ciliary dyskinesias <input type="checkbox"/> Congenital heart disease <input type="checkbox"/> Sickle cell disease <input type="checkbox"/> Immunosuppression <input type="checkbox"/> Cancer <input type="checkbox"/> HIV/AIDS <input type="checkbox"/> Transplant |
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Presence of one or more of these does **NOT** automatically require a CXR.



Feedback Survey

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BRONCHIOLITIS

Clinical considerations for CXR

in children 2mo—2yr with history & exam consistent with bronchiolitis.

If **NONE** of these are present, question your reason for a CXR.

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Presence of one or more of these does **NOT** automatically require a CXR.



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CROUP

Clinical considerations for CXR

in children 6mo—3yr with history & exam consistent with croup.

If **NONE** of these are present, question your reason for a CXR.

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|---|--|
| <ul style="list-style-type: none"> <input type="checkbox"/> Suspected foreign body ingestion or choking episode in past 2 wks <input type="checkbox"/> Fever $\geq 38^{\circ}\text{C}$ (100°F) for ≥ 72 hrs <input type="checkbox"/> Toxic, ill appearance, somnolent, lethargic, or listless <input type="checkbox"/> Focal lung exam findings (decreased breath sounds, rales, rhonchi) or crepitus <input type="checkbox"/> Worsening stridor, accessory muscle use, nasal flaring, head bobbing, severe retractions after standard croup treatment in ED including: <ul style="list-style-type: none"> <input type="checkbox"/> Steroids <input type="checkbox"/> Racemic epinephrine <input type="checkbox"/> Requiring escalation of care: <ul style="list-style-type: none"> <input type="checkbox"/> ≥ 2 doses of racemic epinephrine <input type="checkbox"/> Supplemental oxygen to maintain saturations $>92\%$ | <p style="text-align: center;">Comorbidities</p> <ul style="list-style-type: none"> <input type="checkbox"/> Cerebral palsy &/or neuromuscular disease <input type="checkbox"/> Prematurity (<37 wks gestation) <input type="checkbox"/> Bronchopulmonary dysplasia <input type="checkbox"/> Tracheostomy <input type="checkbox"/> Cystic fibrosis <input type="checkbox"/> Ciliary dyskinesias <input type="checkbox"/> Congenital heart disease <input type="checkbox"/> Sickle cell disease <input type="checkbox"/> Immunosuppression <input type="checkbox"/> Cancer <input type="checkbox"/> HIV/AIDS <input type="checkbox"/> Transplant |
|---|--|

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Why Asthma, Bronchiolitis, & Croup?

GOALS

Reduce CXR utilization & variability of CXR use in common respiratory illnesses seen in EDs

RATIONALE

Asthma, bronchiolitis, & croup are the common respiratory conditions for which children seek emergency care

American Academy of Pediatrics Subcommittee on Diagnosis and Management of Bronchiolitis. Diagnosis and management of bronchiolitis. *Pediatrics*. 2006 Oct;118(4):1774-93.

Choi J, Lee GL. Common pediatric respiratory emergencies. *Emerg Med Clin North Am*. 2012 May;30(2):529-63, x.

Florin TA, et al. Viral bronchiolitis. *Lancet*. 2017 Jan 14;389(10065):211-224

Hanna J, et al. Epidemiological analysis of croup in the emergency department using two national datasets. *Int J Pediatr Otorhinolaryngol*. 2019 Nov;126:109641.

Mansbach JM, et al. Bronchiolitis in US emergency departments 1992 to 2000: epidemiology and practice variation. *Pediatr Emerg Care*. 2005 Apr;21(4):242-7.

Richards AM. Pediatric Respiratory Emergencies. *Emerg Med Clin North Am*. 2016 Feb;34(1):77-96.

Zahran HS, et al. Vital Signs: Asthma in Children - United States, 2001-2016. *MMWR Morb Mortal Wkly Rep*. 2018 Feb 9;67(5):149-155.

LITERATURE

Why chest x-ray for respiratory illness?

GOALS

Reduce CXR utilization & variability of CXR use in common respiratory illnesses seen in EDs

RATIONALE

MEDIC data & literature demonstrate unwarranted variability in CXR use in sites with different patient & provider characteristics

Standard guidance on when a CXR is not likely to reveal clinically-important findings can assist clinicians caring for children in their decision-making processes & reduce variation in care

National Asthma Education and Prevention Program. Expert panel report 3 (EPR 3): Guidelines for the diagnosis and management of asthma-summary report 2007. *J Allergy Clin Immunol.* 2007;120:S94-S138.

Petrocheilou A. et al. Viral Croup: diagnosis and a treatment algorithm. *Pediatr Pulm.* 2014;49(5)

Ralston RL. Et al. Clinical Practice Guideline: The diagnosis, management and prevention of bronchiolitis. From the American Academy of Pediatrics. *Pediatrics.* November 2014; 134 (5)

Society of Hospital Medicine: Pediatric Hospital Medicine. *Choosing Wisely.* 2013 February.
<https://www.choosingwisely.org/clinician-lists/society-hospital-medicine-pediatric-chest-radiographs-for-uncomplicated-asthma-bronchiolitis/>.

Shuh S et al. Evaluation of the utility of radiography in acute bronchiolitis. *J Pediatr.* 2007; 150:429-433

LITERATURE

Why think twice if “NONE of these” are present?

If **NONE** of these are present, question your reason for a CXR.

GOALS

Flip the script – instead of focusing on when to image as the default, guide providers to consider circumstances under which a CXR may not be needed

To signal to providers when a CXR is likely to be low-value

RATIONALE

MEDIC data registry & the medical literature point to this low risk population of children – with none of a group of concerning clinical factors – in whom a CXR is UNLIKELY to reveal findings that require an alternate management decision

National Asthma Education and Prevention Program. Expert panel report 3 (EPR 3): Guidelines for the diagnosis and management of asthma-summary report 2007. *J Allergy Clin Immunol.* 2007;120:S94-S138.

Petrocheilou A. et al. Viral Croup: diagnosis and a treatment algorithm. *Pediatr Pulm.* 2014;49(5)

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Shuh S et al. Evaluation of the utility of radiography in acute bronchiolitis. *J Pediatr.* 2007; 150:429-433

LITERATURE

Why “presence of one or more of these does NOT automatically require a CXR”?

*Presence of one or more of these does **NOT** automatically require a CXR.*

GOALS

Obtaining a CXR in children with asthma, bronchiolitis, or croup should not be automatic but thoughtful

Clinicians can & should use a number of factors when deciding to order a CXR for a child with asthma, bronchiolitis, or croup

RATIONALE

The decision to order a CXR should be weighed against the likelihood that information from the CXR will change your course of treatment or disposition decision

There is insufficient evidence in the published literature to give a specific weight to the clinical factors that may prompt a CXR

Shah SN, et al. Does this child have pneumonia? The rational clinical examination systematic review. *JAMA*. 2017;318(5):462-471.

Chao JH, et al. Predictors of airspace disease on CXR in ED patients with clinical bronchiolitis: A systematic review and meta-analysis. *Academic Emergency Medicine Journal*. Oct 2016;23(10).

LITERATURE

Why *these* comorbidities?

GOALS

Acknowledge that the decision to order a CXR may be influenced by underlying conditions in children with asthma, bronchiolitis or croup

RATIONALE

Identification of certain co morbid conditions that when present in children with asthma, bronchiolitis or croup may require more comprehensive diagnostic evaluation including in some cases a CXR

Presence of these comorbidities does not mean a CXR should be automatically ordered

Comorbidities

- Cerebral palsy &/or neuromuscular disease
- Prematurity (<37 wks gestation)
- Bronchopulmonary dysplasia
- Tracheostomy
- Cystic fibrosis
- Ciliary dyskinesias
- Congenital heart disease
- Sickle cell disease
- Immunosuppression
 - Cancer
 - HIV/AIDS
 - Transplant

What are these guidelines?

- Consensus-driven
- Supported by thoughtful review of evidence
- **Developed for PEM/ED clinicians by:**
 - Practicing ED physicians
 - From multiple health systems
 - Across the state of Michigan
- To optimize ED use of CXR in children with respiratory illness
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ASTHMA

Clinical considerations for CXR
in children 2yr—17yr with known/suspected asthma.

If NONE of these are present, question your reason for a CXR.

Indicators	Contraindications
• Prior AEDC (2021) for ATO risk	• Central (and/or) neuromuscular disease
• Tachypnea, wheezing, stridor, rhinorrhea, or nasal	• Prematurity (<27 wks gestation)
• Poor lung exam findings (decreased breath sounds, hyperinflation) or crackles	• Bronchopulmonary dysplasia
• Chest wheezing/stridor	• Tracheostomy
• Chest pain	• Cystic fibrosis
• Worsening asthma: muscle use, nasal flaring, head bobbing, severe retractions after standard asthma treatment in ED including: <ul style="list-style-type: none">• 3 treatments with inhaled beta agonist + steroid	• Olanoprost
• Requiring escalation of care: <ul style="list-style-type: none">• Continuous albuterol, magnesium, ketamine, nebulator• Supplemental oxygen to maintain saturations >92%	• Congenital heart disease

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Indicators	Contraindications
• Prior AEDC (2021) for ATO risk	• Central (and/or) neuromuscular disease
• Tachypnea, wheezing, stridor, or rhinorrhea	• Prematurity (<27 wks gestation)
• Poor lung exam findings (decreased breath sounds, hyperinflation) or crackles	• Bronchopulmonary dysplasia
• Chest wheezing/stridor	• Tracheostomy
• Chest pain	• Cystic fibrosis
• Worsening asthma: muscle use, nasal flaring, head bobbing, severe retractions	• Olanoprost
• Requiring escalation of care: <ul style="list-style-type: none">• High flow oxygen• CPAP, BiPAP• Intubation	• Congenital heart disease

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CROUP

Clinical considerations for CXR
in children 6mo—3yr with history & exam consistent with croup.


If NONE of these are present, question your reason for a CXR.

Indicators	Contraindications
• Suspended foreign body (together or in a single episode) in past 2 wks	• Central (and/or) neuromuscular disease
• Prior AEDC (2021) for ATO risk	• Prematurity (<27 wks gestation)
• Tachypnea, wheezing, stridor, or rhinorrhea	• Bronchopulmonary dysplasia
• Poor lung exam findings (decreased breath sounds, hyperinflation) or crackles	• Tracheostomy
• Chest wheezing/stridor	• Cystic fibrosis
• Worsening asthma: muscle use, nasal flaring, head bobbing, severe retractions after standard group treatment in ED including: <ul style="list-style-type: none">• Steroids• Racemic epinephrine	• Olanoprost
• Requiring escalation of care: <ul style="list-style-type: none">• 30 doses of racemic epinephrine• Supplemental oxygen to maintain saturations >92%	• Congenital heart disease
	• Stroke or disease
	• Intubation/airway
	• Cardiac
	• HIV/AIDS
	• Transplant

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Presence of one or more of these does NOT automatically require a CXR.

Feedback Survey



Key References

- American Academy of Pediatrics Subcommittee on Diagnosis and Management of Bronchiolitis. Diagnosis and management of bronchiolitis. *Pediatrics*. 2006 Oct;118(4):1774-93.
- Chamberlain JM, et al. Practice pattern variation in the care of children with acute asthma. *Academic Emergency Medicine Journal*. Feb 2016; 23(2).
- Chao JH, et al. Predictors of airspace disease on CXR in ED patients with clinical bronchiolitis: A systematic review and meta-analysis. *Academic Emergency Medicine Journal*. Oct 2016;23(10).
- Choi J, Lee GL. Common pediatric respiratory emergencies. *Emerg Med Clin North Am*. 2012 May;30(2):529-63, x.
- Florin TA, et al. Pneumonia in children presenting to the emergency department with asthma exacerbation. *JAMA Pediatr*. 2016 Aug 1;170(8):803-5.
- Florin TA, et al. Viral bronchiolitis. *Lancet*. 2017 Jan 14;389(10065):211-224.
- Hanna J, et al. Epidemiological analysis of croup in the emergency department using two national datasets. *Int J Pediatr Otorhinolaryngol*. 2019 Nov;126:109641.
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Key References cont'd

- National Asthma Education and Prevention Program. Expert panel report 3 (EPR 3): Guidelines for the diagnosis and management of asthma-summary report 2007. *J Allergy Clin Immunol*. 2007;120:S94-S138. **This document can also be found here:** <https://www.nhlbi.nih.gov/health-topics/guidelines-for-diagnosis-management-of-asthma>.
- Petrocheilou A, et al. Viral Croup: diagnosis and a treatment algorithm. *Pediatr Pulm*. 2014;49(5).
- Ralston RL, et al. Clinical Practice Guideline: The diagnosis, management and prevention of bronchiolitis. From the American Academy of Pediatrics. *Pediatrics*. November 2014; 134 (5).
- Richards AM. Pediatric Respiratory Emergencies. *Emerg Med Clin North Am*. 2016 Feb;34(1):77-96.
- Shah SN, et al. Does this child have pneumonia? The rational clinical examination systematic review. *JAMA*. 2017;318(5):462-471.
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