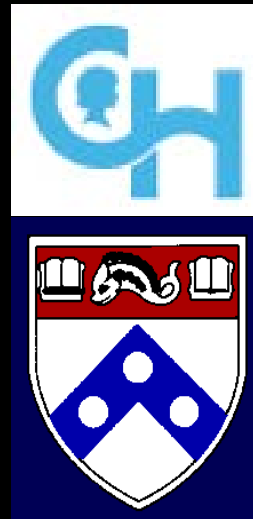


# Pediatric Respiratory Disease: A Model for the Future of Emergency Medicine Research

Joseph J. Zorc, MD, MSCE

Mark Fishman Professor, Department of Pediatrics  
Perelman School of Medicine, University of Pennsylvania  
Director, Emergency Information Systems  
The Children's Hospital of Philadelphia



## Disclosures

Financial: No interests to disclose

Professional: Academic medicine career

- Interventional research in respiratory illness
  - Randomized trials in asthma / bronchiolitis
  - NHLBI K 23 Award
  - American Academy of Pediatrics (AAP) & PECARN multicenter research
  - AAP Bronchiolitis Guideline
  - Formal Quality Improvement training at Intermountain Health Care
- Information Technology
  - Initially administrative role, ED tracking system
  - Implemented full EHR functionality gradually over 15 years
  - Clinical Informatics Board Certification
  - Teaching and involvement in CHOP Clinical Informatics fellowship

# Top 5 Reasons to Become an Emergency Medicine Researcher

1.

2.

3.

4.

5.

# Bronchiolitis



## CLINICAL PRACTICE GUIDELINE

### Clinical Practice Guideline: The Diagnosis, Management, and Prevention of Bronchiolitis

#### abstract

This guideline is a revision of the clinical practice guideline, "Diagnosis and Management of Bronchiolitis," published by the American Academy of Pediatrics in 2006. The guideline applies to children from 1 through 23 months of age. Other exclusions are noted. Each key action statement indicates level of evidence, benefit/harm relationship, and level of recommendation. Key action statements are as follows. *Pediatrics* 2014;134:e1474-e1502

FREE

Shawn L. Ralston, MD, FAAP; Allan S. Lieberthal, MD, FAAP; H. Cody Meissner, MD, FAAP; Brian K. Alverson, MD, FAAP; Jill E. Baley, MD, FAAP; Anne M. Gadomski, MD, MPH, FAAP; David W. Johnson, MD, FAAP; Michael J. Light, MD, FAAP; Nizar F. Marzouq, MD, FAAP; Eneida A. Mendonca, MD, PhD, FAAP; FACM; Kieran J. Phelan, MD, MSc; Joseph J. Zorc, MD, MSCE; FAAP; Danette Stanko-Lopp, MA, MPH, Mark A. Brown, MD; Ian Nathanson, MD, FAAP; Elizabeth Rosenblum, MD; Stephen Sayles III, MD, FACEP; and Sinsi Hernandez-Canoio, JD

#### KEY WORDS

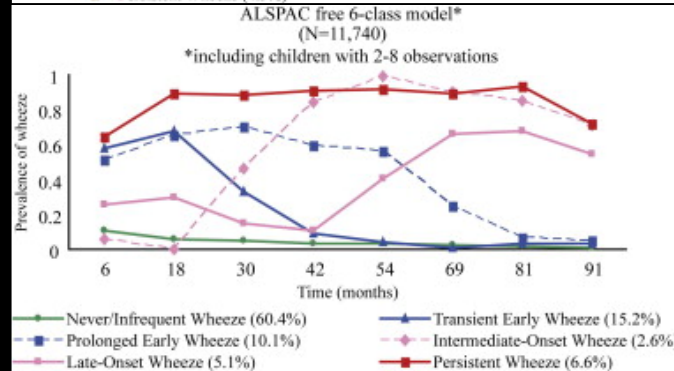
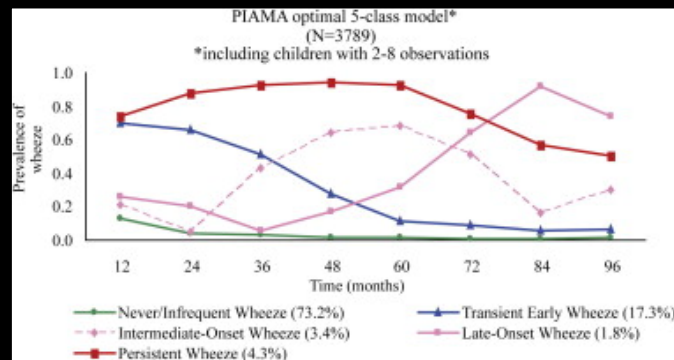
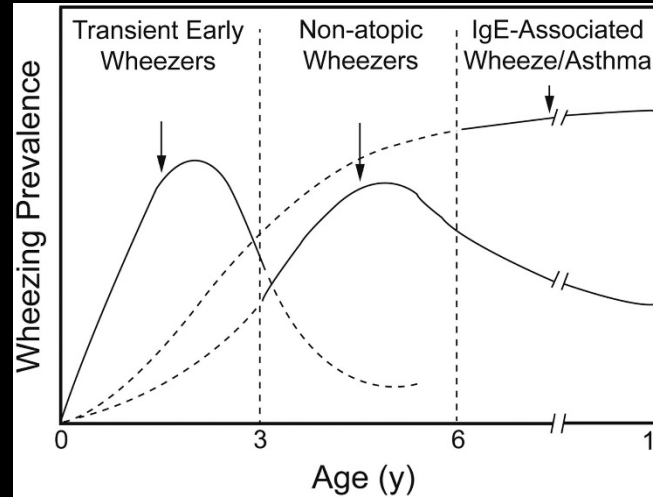
bronchiolitis, infants, children, respiratory syncytial virus, evidence-based, guideline

#### ABBREVIATIONS

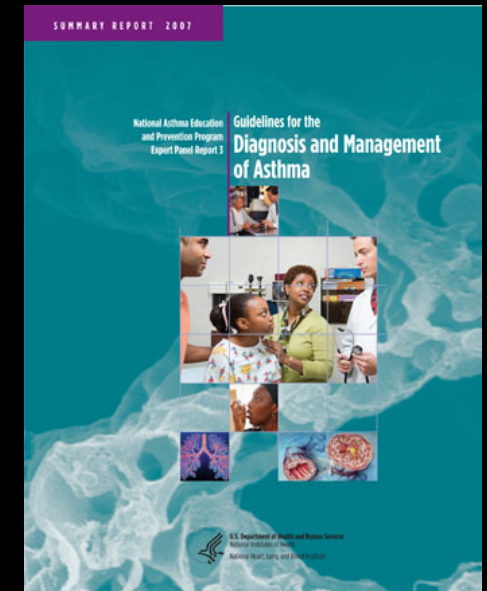
AAP—American Academy of Pediatrics  
DOI—acute otitis media

#### DIAGNOSIS

1a. Clinicians should diagnose bronchiolitis and assess disease se-



# Asthma



## Top 5 Reasons to Become an EM Researcher

5. New opportunities to translate evidence effectively



The Doctor, Sir Luke Fildes, 1887



c/o Ted Eyton <http://www.flickr.com/photos/taedc/sets/72157633347033275/>

## Promise of IT to improve healthcare

*Health IT's failure to quickly deliver on its promise is not due to its lack of potential but to shortcomings in the design and implementation of health IT systems...*

*Ultimately, there is only so much that the government and vendors can do. Providers must do their part by reengineering existing processes of care to take full advantage of the efficiencies offered by Health IT*

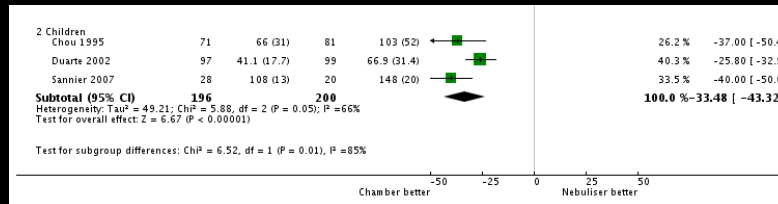
Arthur Kellerman, *Health Affairs* 2013



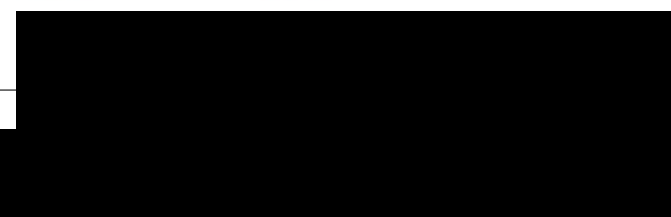
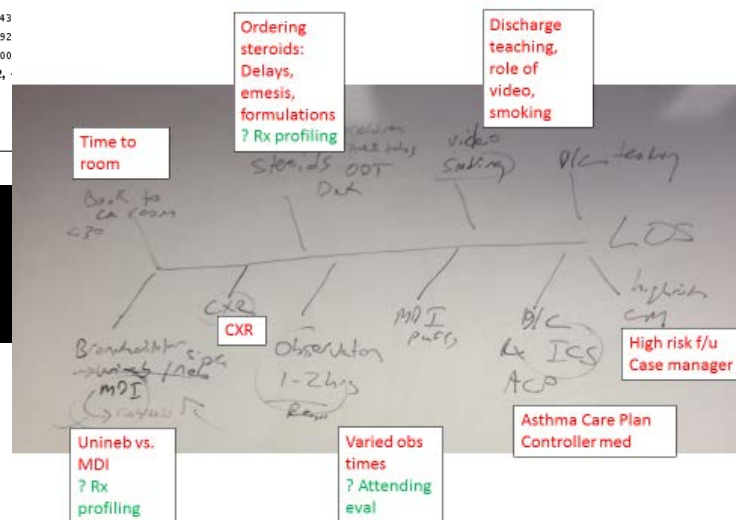
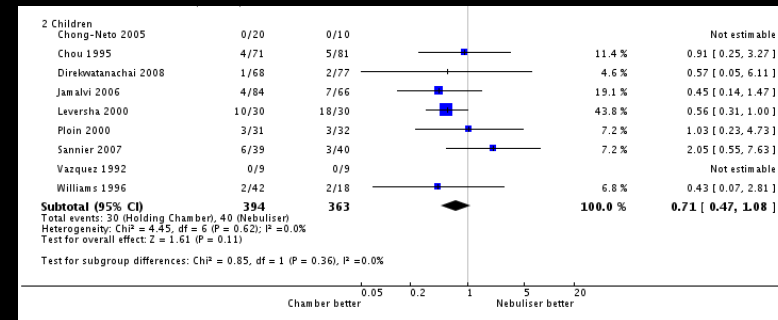
# Mild-Moderate asthma in the CHOP ED

Problem: Overtreatment with neb instead of MDI

- Evidence review showed benefit of MDI
- Multi-disciplinary review / Process analysis
  - Key Driver: MD/NPs reluctant to order MDI: Concern about reassessment
  - Duplicated resources: MDI given at discharge
  - Measurements: MDI use, length of stay, admissions



Evidence for reduced length of stay  
Trend towards reduced admissions



## CHOP Asthma Pathway: MDI QI Project

### Problem:

- Overtreatment of mild-moderate patients
- MDI instead of neb reduces length of stay / costs

### Intervention:

- Order set modification
- Explicit options based on triage level
- Mild-moderate (ESI Triage 3/4): MDI puffs q20 x 3
- Conditional order: Respiratory to stop when improved

### Goal:

- Increase % of ESI 3 /4 pts discharged in < 3 hrs by 10% within 3 months

Related Pathway:

[Inpatient Asthma Practice Pathway](#)  
[Primary Care Acute Asthma Pathway](#)

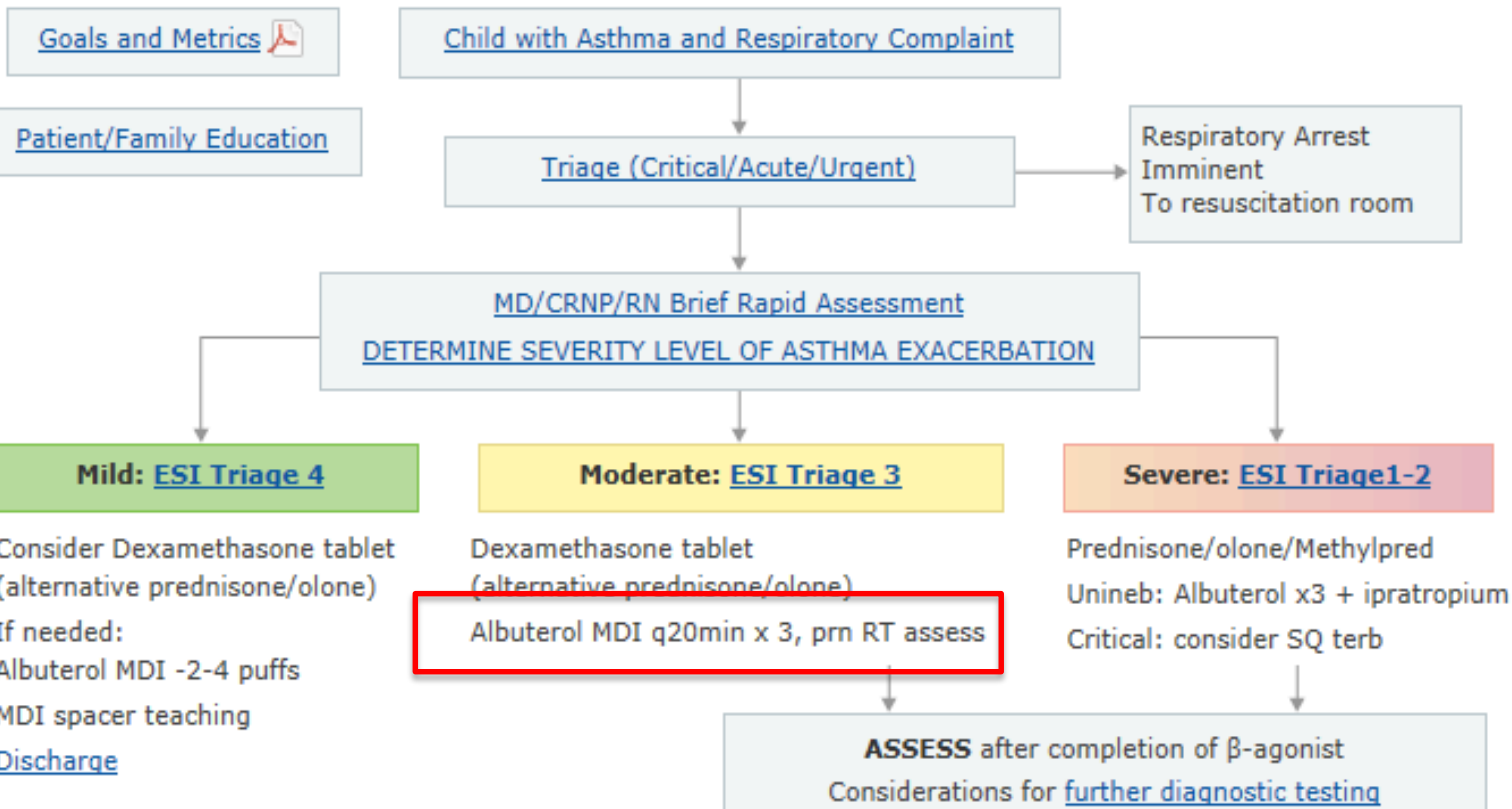
ED Pathway for Evaluation/Treatment of Children with Asthma

Learn More

[Learning Link Module \(for CRNP employees\)](#)

**Related Pathway:**  
[Inpatient Asthma Practice Pathway](#)  
[Primary Care Acute Asthma Pathway](#)

# ED Pathway for Evaluation/Treatment of Children with Asthma



[Goals and Metrics](#)

[Patient/Family Education](#)

[Child with Asthma and Respiratory Complaint](#)

[Triage \(Critical/Acute/Urgent\)](#)

Respiratory Arrest Imminent To resuscitation room

[MD/CRNP/RN Brief Rapid Assessment DETERMINE SEVERITY LEVEL OF ASTHMA EXACERBATION](#)

**Mild: ESI Triage 4**

Consider Dexamethasone tablet (alternative prednisone/olone)  
If needed:  
Albuterol MDI -2-4 puffs  
MDI spacer teaching  
[Discharge](#)

**Moderate: ESI Triage 3**

Dexamethasone tablet (alternative prednisone/olone)  
Albuterol MDI q20min x 3, prn RT assess

**Severe: ESI Triage 1-2**

Prednisone/olone/Methylpred  
Unineb: Albuterol x3 + ipratropium  
Critical: consider SQ terb

**ASSESS** after completion of  $\beta$ -agonist  
Considerations for [further diagnostic testing](#)

<b>Albuterol Waig</b>	
Kg	Unit D
5-10	2.5 mg
> 10-20	3.75 mg
> 20	5 mg
<b>Ipratropium W</b>	
5-10	500 mc unineb 250 mc
> 10	1000 mc unineb 500 mc
<b>Prednisone/M</b>	
	2 mg/kg mg
<b>Dexamethason</b>	
hours, crush tabl	
5-8	4 mg
> 8-12	6 mg
> 12	8 mg
<b>Magnesium Sul</b>	
	50 mg
Gral. w/ bolus, liter	
<b>Terbutaline</b>	
Subcut	0.01 mg
Bolus	10 mg
(Range 2-30 mcg/kg) MAX 750 mcg	
Inhalation (consider intermittent boluses as alternative)	
Starting dose: 0.4 mcg/kg/min	
(Range 0.4 mcg/kg-3 mcg/kg/min)	
Titrate to Max 3 mcg/kg/min	

October 2014, April 2015  
**Authors:** J. Zorc, MD; R. Scarfone, MD; A. Reardon, CRNP; N. Strouhal, CRNP; W. Frankenberg, RN; L. Tyler, RT; D. Simpkins, RT; R. Abaya, MD; E. Delgado, MD; E. Brill, RN



chop pathways

Clinical Pathways Program | Children's Hospital of Philadelphia  
[www.chop.edu/pathways](http://www.chop.edu/pathways)

Our Clinical Pathways Program within the Office of Clinical Quality Improvement aims to ... Learn more about the Clinical Pathways Program at CHOP ...

- Very explicit instructions and indications

## Order Sets

### ED Asthma Pathway

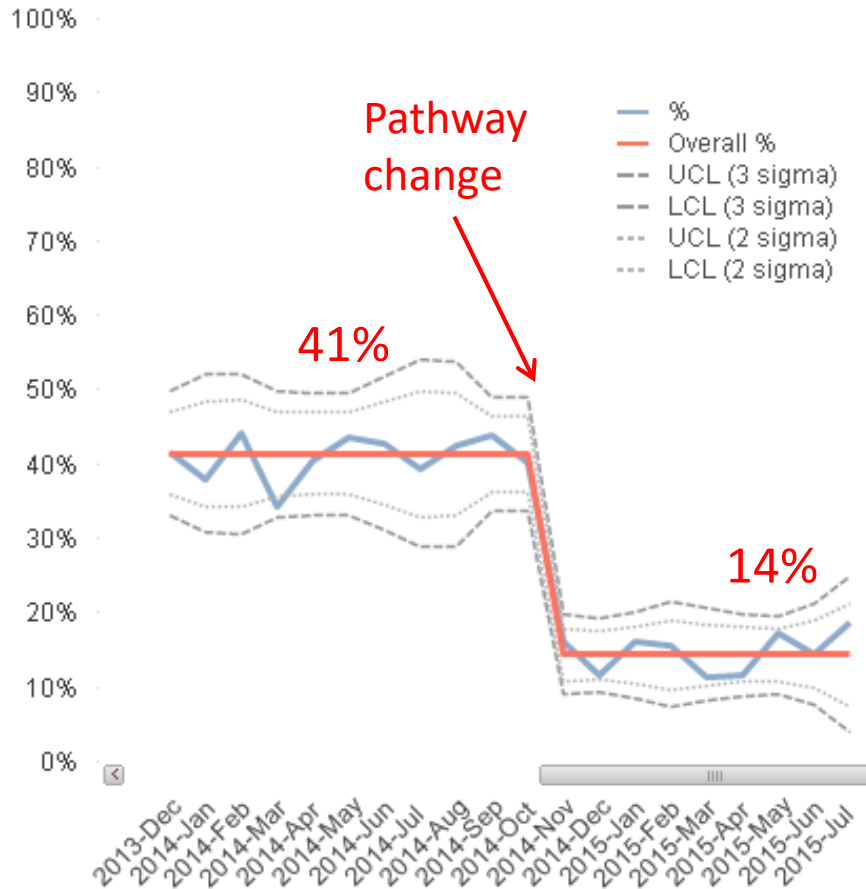
#### ED Asthma Pathway

##### ED Asthma Pathway: Pharmacy

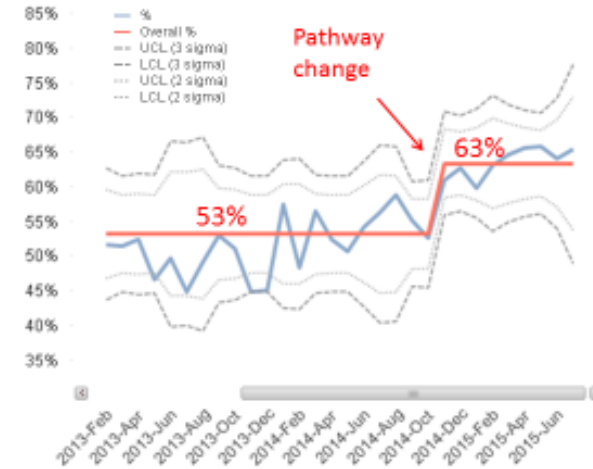
- ▶ Steroids: Order on arrival if not responding to home treatment 0 of 6 selected
- ▶ Mild Bronchodilator (ESI 4, Minimal/NoWOB): Administer 2-4 puffs if needed and place orders for discharge teaching/prescriptions 0 of 4 selected
- ▼ Moderate Bronchodilator (ESI 3, Mild WOB): Administer puffs, RT to reassess and repeat prn, observe 1 hour after treatment prior to discharge
  - albuterol inhaler 4 puffs: 5-10kg
  - albuterol inhaler 6 puffs: 10-20kg
    - albuterol HFA (ED Only HOME USE) 108 (90 BASE) mcg/ACT oral inh 6 puff(s)  
6 puff(s) (0.06 Puff/kg), Inhaled, ONCE, 1 dose Today at 1445
    - albuterol HFA (ED Only HOME USE) 108 (90 BASE) mcg/ACT oral inh 6 puff(s)  
6 puff(s) (0.06 Puff/kg), Inhaled, EVERY 20 MIN PRN, 2 doses starting Today at 1437 Until Discontinued, Other, prn moderate or severe assesment, if mild notify MD/NP and discontinue repeat assessments
  - albuterol inhaler 8 puffs: > 20kg
  - Instruct patient/family member in the use of metered dose inhaler/spacer
  - Smoking Cessation Education  
Please provide ED smoking cessation education.
- ▶ Severe Bronchodilator (ESI 1/2, Mod-Severe WOB): Administer albuterol/ipratropium via unineb over 1 hour, observe 1-2 hours prior to discharge 0 of 4 selected
- ▶ Poor response to initial therapy (Mod-Severe WOB): Repeat unineb, consider IV Mg wih NS bolus 0 of 3 selected
- ▶ Severe without response: Continuous albuterol, place IV. Consider IV terbutaline bolus after IV Mg if admitted to ICU 0 of 3 selected
- ▼ Asthma Discharge Teaching

**Embedded order panel**

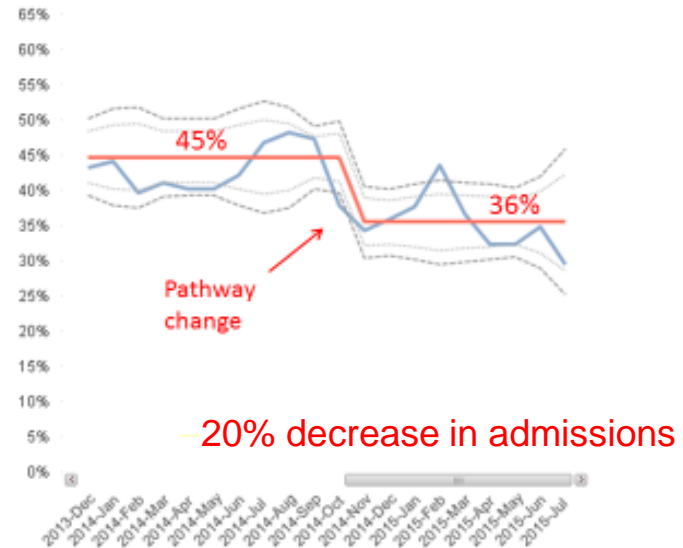
## ESI Triage 3-4 Discharged Patients % Use of 1 hr continuous neb



## ESI Triage 3-4 Discharged Patients: % Discharged within 3 hrs.



## Overall ED Asthma Admission Rate

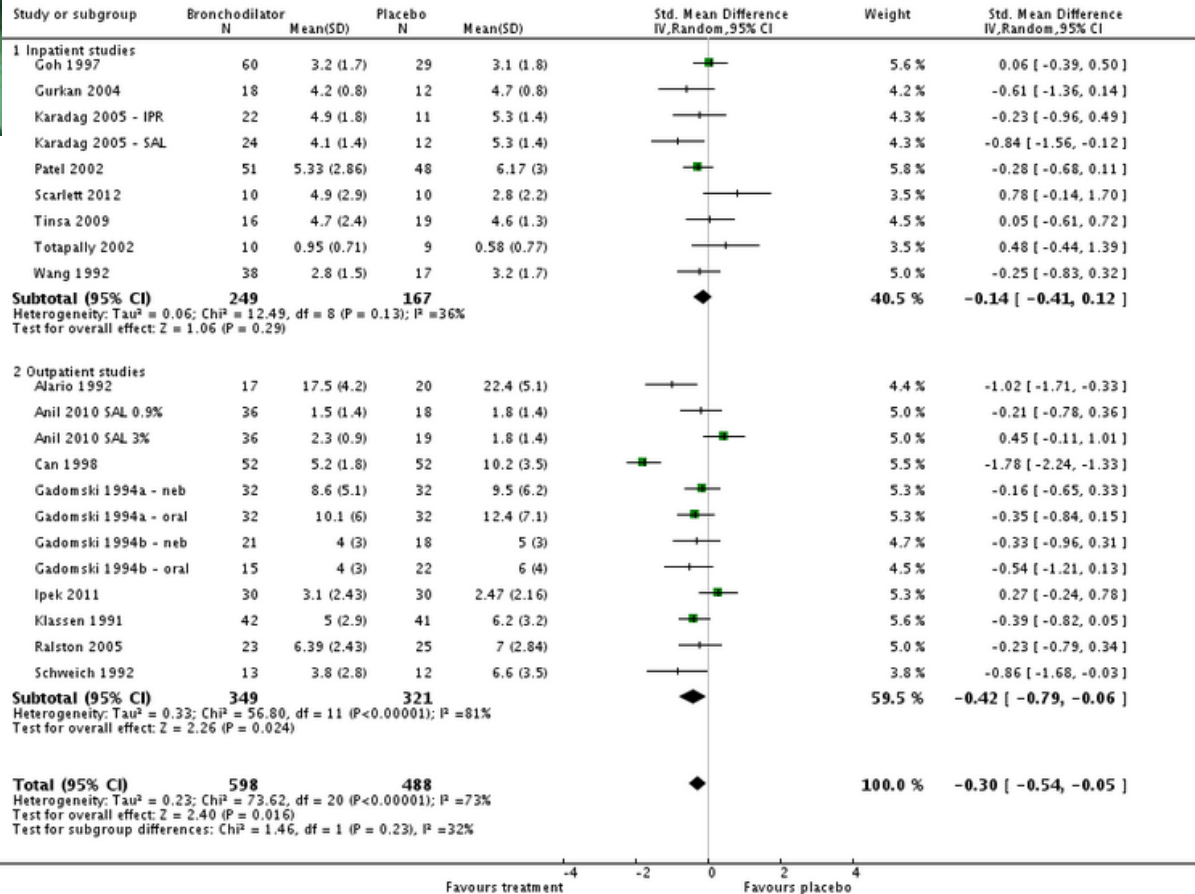




# Bronchodilator effect on clinical score for bronchiolitis

## Gadomski, Cochrane Reviews 2014

Review: Bronchodilators for bronchiolitis  
 Comparison: 1 Bronchodilators compared to placebo for treatment of acute bronchiolitis  
 Outcome: 4 Average clinical score after treatment: by treatment setting (continuous)



Inpatient

Outpatient

Bronchodilator Placebo

# 2014 AAP Bronchiolitis Guideline

*Committee:*

*A group who individually can do nothing,  
but together can decide that nothing can be done*

**Fred Allen**

American Academy  
of Pediatrics  
DEDICATED TO THE HEALTH OF ALL CHILDREN™



CLINICAL PRACTICE GUIDELINE

## Clinical Practice Guideline: The Diagnosis, Management, and Prevention of Bronchiolitis

### abstract

FREE

This guideline is a revision of the clinical practice guideline, "Diagnosis and Management of Bronchiolitis," published by the American Academy of Pediatrics in 2006. The guideline applies to children from 1 through 23 months of age.

ment indicat  
of recommen  
2014;134:e14

Shawn L. Ralston, MD, FAAP, Allan S. Lieberthal, MD, FAAP, H. Cody Meissner, MD, FAAP, Brian K. Alverson, MD, FAAP, Jill E. Baley, MD, FAAP, Anne M. Gadomski, MD, MPH, FAAP, David W. Johnson, MD, FAAP, Michael J. Light, MD, FAAP, Nizar F. Maraga, MD, FAAP, Eneida A. Mendonca, MD, PhD, FAAP, FACMI, Kieran J. Phelan, MD, MSc, Joseph J. Zorc, MD,

**Clinicians should not administer albuterol to infants and children with a diagnosis of bronchiolitis (Evidence Quality: B; Recommendation Strength: Strong Recommendation).**

Respiratory Syncytial Virus (RSV) is a common, seasonal virus contracted by nearly 100% of babies by the age of 2, and is the leading cause of hospitalization for babies during their

first year of life in the U.S. And, is at risk for developing RSV disease. Babies are twice as likely as to be hospitalized for RSV-related

Since 1999, an FDA-approved vaccine has been available to significantly reduce the number of hospitalizations due to RSV among high-risk infants.

Take action to help protect your child.  
Visit RSVFacts.org

But every few years, it commences within the American Academy of Pediatrics (AAP) issues recommendations that progressively narrow the population of babies they believe should

## EDITORIAL

# American Academy of Pediatrics 2014 Bronchiolitis Guidelines: Bonfire of the Evidence

**Paul Walsh, MD, MSc\*†**  
**Stephen J. Rothenberg, PhD‡**

\*University of California, Davis, Department of Emergency Medicine, Davis, California  
†Sutter Medical Centers of Sacramento, Pediatric Emergency Medicine, Sacramento, California

‡Instituto Nacional de Salud Pública, Centro de Investigación en Salud Poblacional, Cuernavaca, Morelos, Mexico

*Supervising Section Editor:* Mark I. Langdorf, MD, MHPE

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DOI: 10.5811/westjem.2015.1.24930

[West J Emerg Med. 2015;16(1):85–88.]





From:

Pediatric Emergency Medicine Discussion List <PED-EM-L@LISTSERV.BROWN.EDU>

Jay Fisher <jdfisher1@COX.NET>

To:

PED-EM-L@LISTSERV.BROWN.EDU

Cc:

Subject:

My name is Dr. Indigo Montoya, You Killed Albuterol..

... prepare to die.

In face of the recent  
will be endorsing this  
Our center will serve  
therapy for the treat

It is my hypothesis t

I anxiously await the

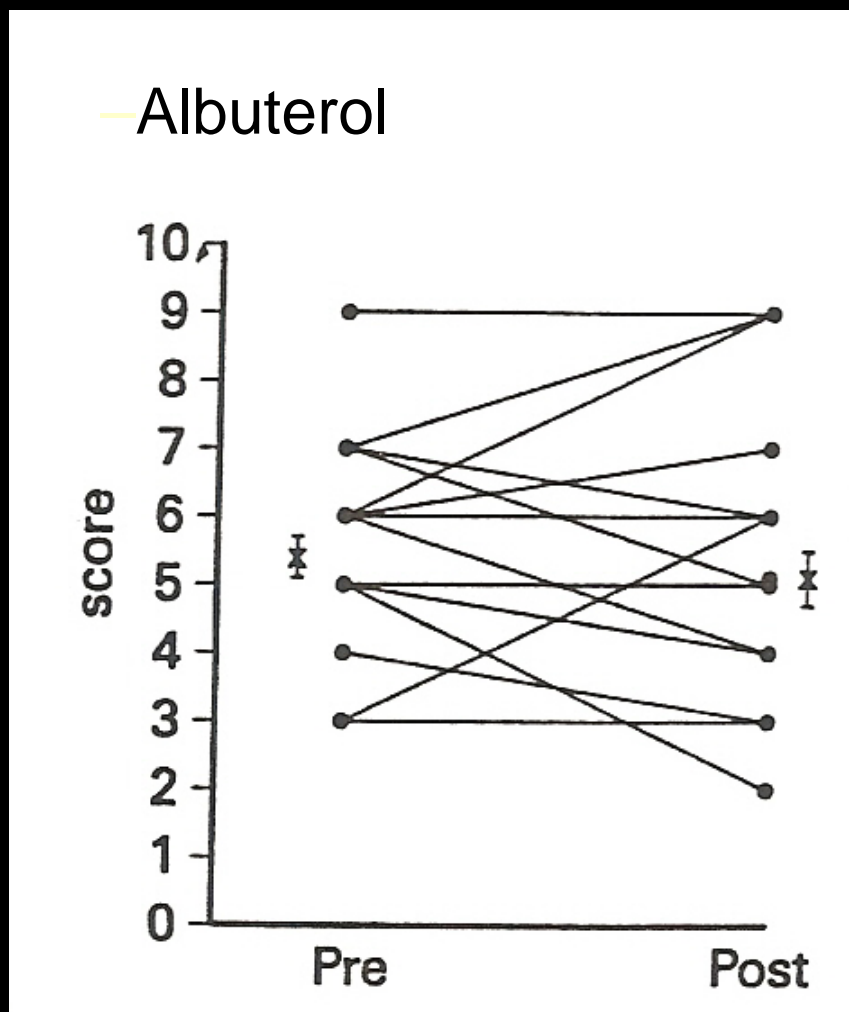


You killed my father.  
Prepare to die.

am re  
ny non  
a new  
ts.'

be the

N=24, 1<sup>st</sup> episode of bronchiolitis, sedated with chloral hydrate



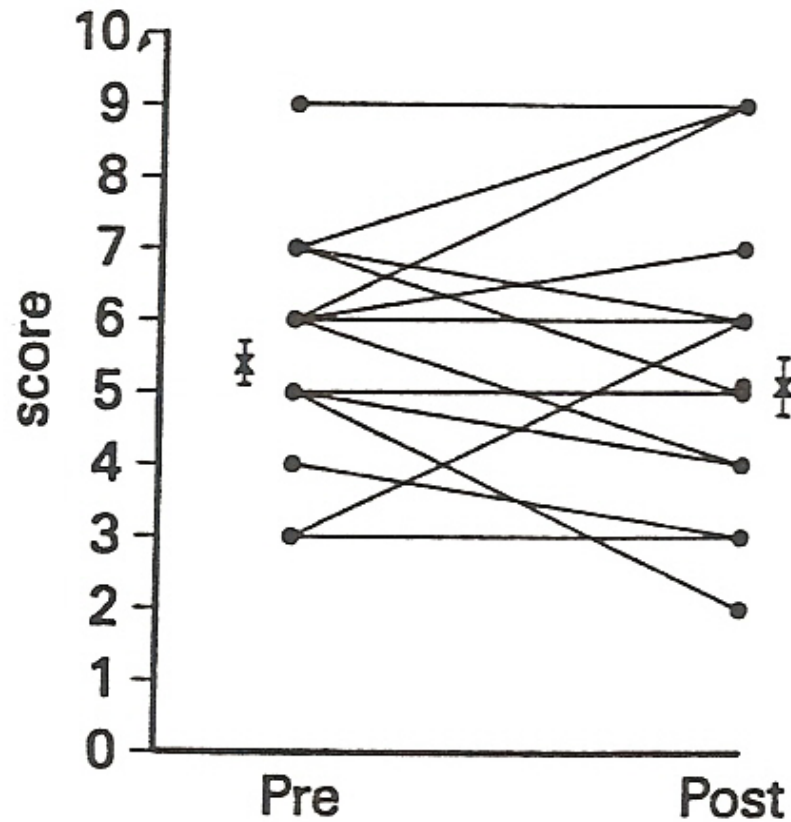
Typical variation  
of infants with bronchiolitis?

Varied response?

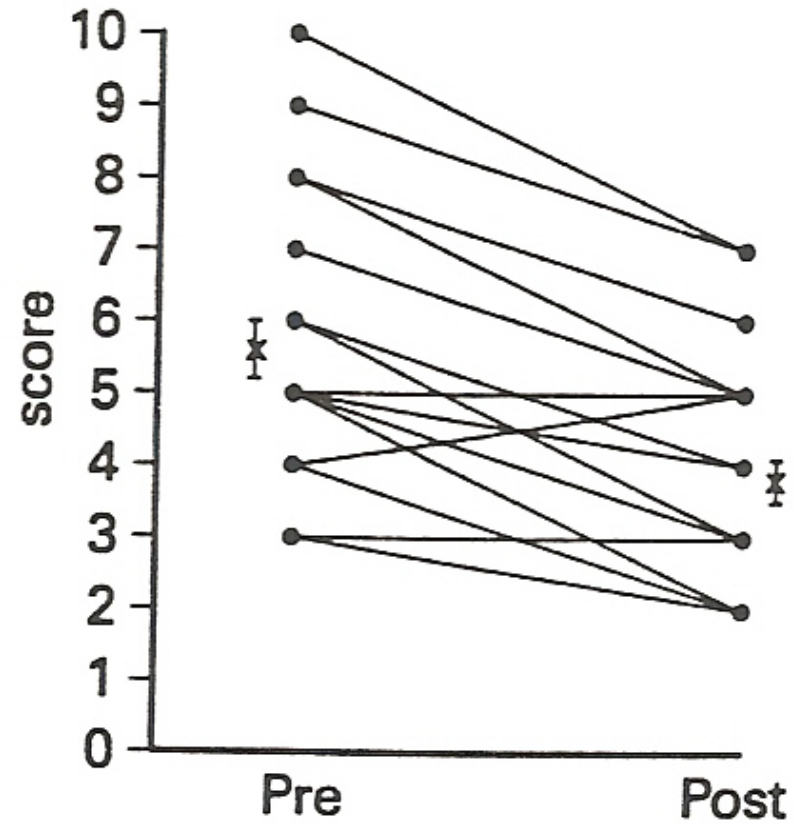
No significant change in score or PFTs with albuterol (salbutamol)

*Sanchez et al. Journal of Pediatrics, 1993*

Albuterol



Racemic Epinephrine



Related Pathway:  
Inpatient Bronchiolitis  
Pathway

## ED Pathway for Evaluation/Treatment of Children with Bronchiolitis



### Bronchodilator Trial

— “Do Not Order” Set

#### ED Bronchiolitis Pathway

##### ED Bronchiolitis Pat

###### Supportive Care

Suction Nares per

###### Medications

###### Bronchodilators

Not recommended for

Albuterol Bronchid

racemic EPINEPH

###### Steroids: Not reco

###### Laboratory

###### Laboratory tests: V

Respiratory Virus

###### Radiology

###### Radiology: Chest

XR Chest 2vw AP

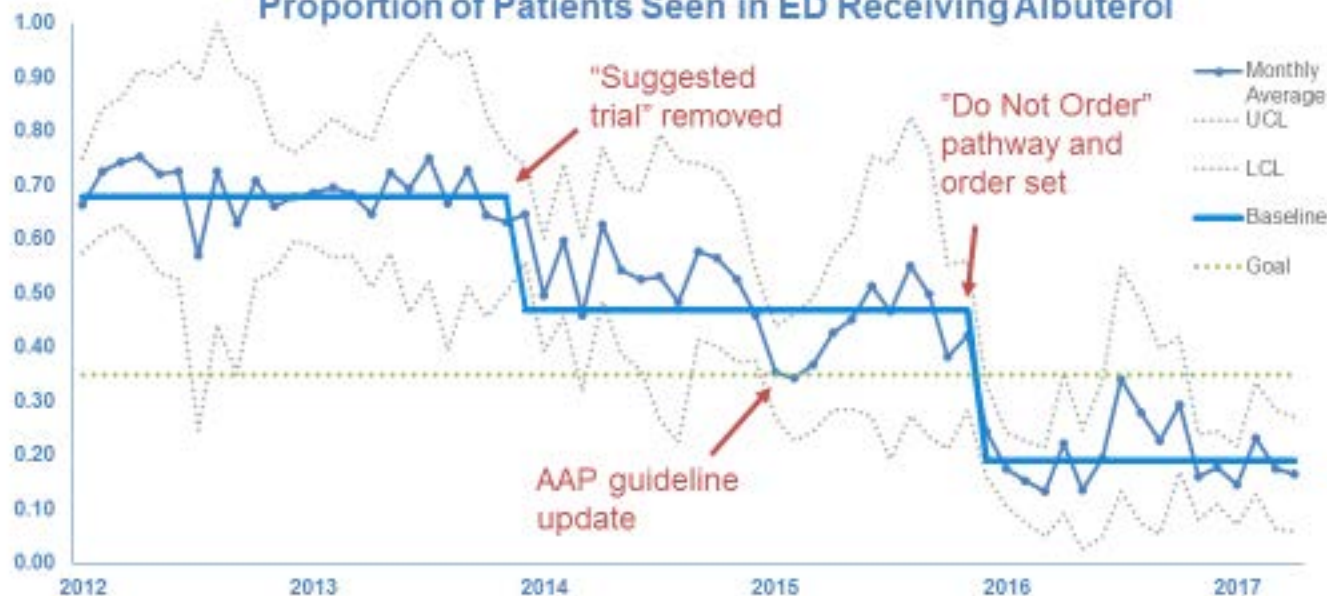
Improve

Goal: < 3

% of All  
120%  
100%  
80%  
60%  
40%  
20%  
0%  
% Patients  
Definition

## CHOP Bronchiolitis Pathway

### Proportion of Patients Seen in ED Receiving Albuterol



— No change in admission, LOS, revisits



chop bronchiolitis

# Key to effective care for asthma and bronchiolitis

**Related Pathway:**  
[Inpatient Asthma Practice Pathway](#)  
[Primary Care Acute Asthma Pathway](#)

**ED Pathway for Evaluation/Treatment of Children with Asthma**

[Learn More](#)  
[LumenLink Module](#)

**Goals and Metrics** | **Child with Asthma and**

**MD/CN/PA/NP/BSN DETERMINE SEVERE STATUS**

**Mild: ESI Triage 4** | **Moderate**

Consider prednisone/orbital or Dexamethasone  
 If needed:  
 Albuterol MDI 2-4 puffs  
 MDI spacer teaching  
[Discharge](#)

Prednisone/orbital  
 Albuterol MDI q2h

Albuterol Weight-based Dosing			
Kg	Unit Dose (0.5%)	MDI Puffs	Continuous
5-10	2.5 mg (0.5 mL)	4	7.5 mg/hr
> 10-20	3.75 mg (0.75mL)	6	11.25 mg/hr
> 20	5 mg (1.0 mL)	8	15 mg/hr

Ipratropium Weight-based Dosing			
5-10	> 10		
500 mcg over 1 hr in unalbut or 250 mcg q20 min x 2	1000 mcg over 1 hr in unalbut or 500 mcg q20 min x 2		

Prednisone/Methylprednisolone	
2 mg/kg p.o./IV, MAX 60 mg	

Dexamethasone: MDI, methylprednisolone, nasal or 24-48 hours, crush tablet with cherry syrup, juice, or yogurt	
5-8	4 mg
> 8-12	6 mg
> 12	8 mg

Magnesium Sulfate	
50 mg/kg, MAX 2 g	
Give with Normal Saline bolus, 20mL/kg (max 1 liter)	

Terbutaline	
Subcutaneous:	
0.01 mg/mL/kg MAX 0.25 mg (0.25 mL)	
Bolus	
10 mg/kg (Range 2-30 mg/kg) MAX 750 mg	
Infusion (consider intermittent boluses as alternative)	
Starting dose 0.4 mg/kg/min (Range 0.4 mg/kg-3 mg/kg/min)	
Titrate to Max 3 mg/kg/min	

Updated 2024, April 2025

**Authors:** J. Zoc, MD; R. Scarfone, MD; A. Reardon, CRNP; N. Strubel, CRNP; W. Frankenburg, RN; L. Tyler, RT; D. Simpkins, RT; R. Abaya, MD; E. Delgado, MD; E. Brill, RN;

**Related Pathway:**  
[Inpatient Bronchiolitis Pathway](#)

**ED Pathway for Evaluation/Treatment of Children with Bronchiolitis**

**Additional Treatment Considerations**  
 Albuterol Trial  
 Racemic epinephrine  
 Antibiotics  
 Hypertonic Saline  
[Further Diagnostic Testing](#)

Consider **ED Asthma Pathway** if:  
 Recurrent wheezing / prior steroid use  
 Age > 12 months  
 Strong response to albuterol

**Severe**

Suction: Bulb or wall  
[Bronchodilators](#) not recommended for **typical bronchiolitis**. If used, document reason and response.

If no improvement after suctioning, assess with attending at bedside to discuss additional treatment including initiating HFNC oxygen - [View Job Aid](#)

**Discharge Criteria**

on on:  
 assessments  
 to therapy  
 iness

**Discharge criteria not met:**  
 Requires O<sub>2</sub> or progression expected  
 Mild disease with expected LOS < 24 hours  
 As, severe distress  
 Requires HFNC / CPAP / intubation

**When these risk factors present early in the higher risk of progression:**  
 Gestational age < 34 weeks  
 Respiratory rate ≥ 70  
 Age < 3 months

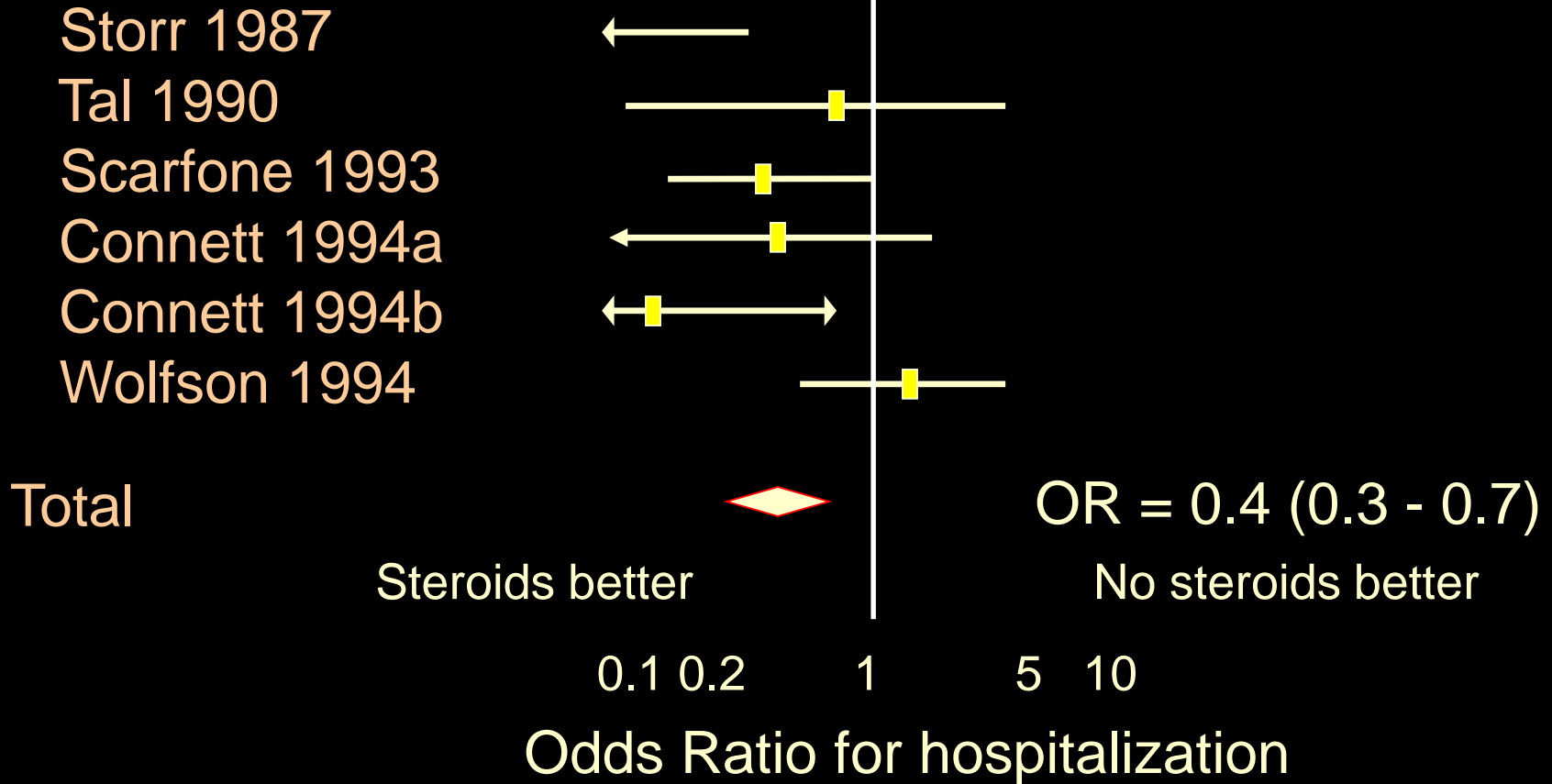


## Top 5 Reasons to Become an EM Researcher

4. Build a career in academic medicine
5. New opportunities to translate evidence effectively

# Systemic steroids for acute asthma: Cochrane meta-analysis

## Pediatric studies



Rowe et al. Cochrane Database 2005

# Triage Nurse Initiation of Corticosteroids in Pediatric Asthma Is Associated With Improved Emergency Department Efficiency

**AUTHORS:** Roger Zemek, MD,<sup>a</sup> Amy Plint, MD, MSc,<sup>a</sup> Martin H. Osmond, MD, CM,<sup>a</sup> Tom Kovsesi, MD,<sup>a</sup> Rhonda Correll, BScN,<sup>b</sup> Nicholas Perri,<sup>c</sup> and Nick Barrowman, PhD<sup>b</sup>

<sup>a</sup>Department of Pediatrics, Children's Hospital of Eastern Ontario, University of Ottawa, Ottawa, Ontario, Canada; <sup>b</sup>Clinical Research Unit, Children's Hospital of Eastern Ontario Research Institute, Ottawa, Ontario, Canada; and <sup>c</sup>Faculty of Medicine, University of Ottawa, Ottawa, Ontario, Canada

## KEY WORDS

asthma, pediatrics, emergency department, multidisciplinary teams, medical directive

## ABBREVIATIONS

CI—confidence interval

ED—emergency department

PRAM—Pediatric Respiratory Assessment Measure



**WHAT'S KNOWN ON THIS SUBJECT:** Early administration of oral corticosteroids is essential for children presenting to emergency departments with moderate to severe acute asthma exacerbations, because subsequent admission need is directly related to time to receipt of systemic steroids, yet delays to administration remain long.



**WHAT THIS STUDY ADDS:** A medical directive allowing nurse initiation of oral corticosteroids before physician assessment was associated with improved quality and efficiency of care provided in the pediatric emergency department by ensuring implementation of evidence-based practice.

**TABLE 3** Secondary Outcomes

Outcome	Physician-Ordered Phase	Nurse-Initiated Phase	Group Difference <sup>a</sup>
Hospital admission rate	19.0%	11.7%	OR = 0.56 (95% CI: 0.36–0.87)
Time to receipt of steroids	72 min (IQR: 43–125)	28 min (IQR: 15–43)	44 min (95% CI: 39–51)
Time to “mild” status	262 min (IQR: 239–290)	211 min (IQR: 197–238)	51 min (95% CI: 17–84)
Time to discharge	360 min (IQR: 341–380)	316 min (IQR: 303–340)	44 min (95% CI: 17–68)

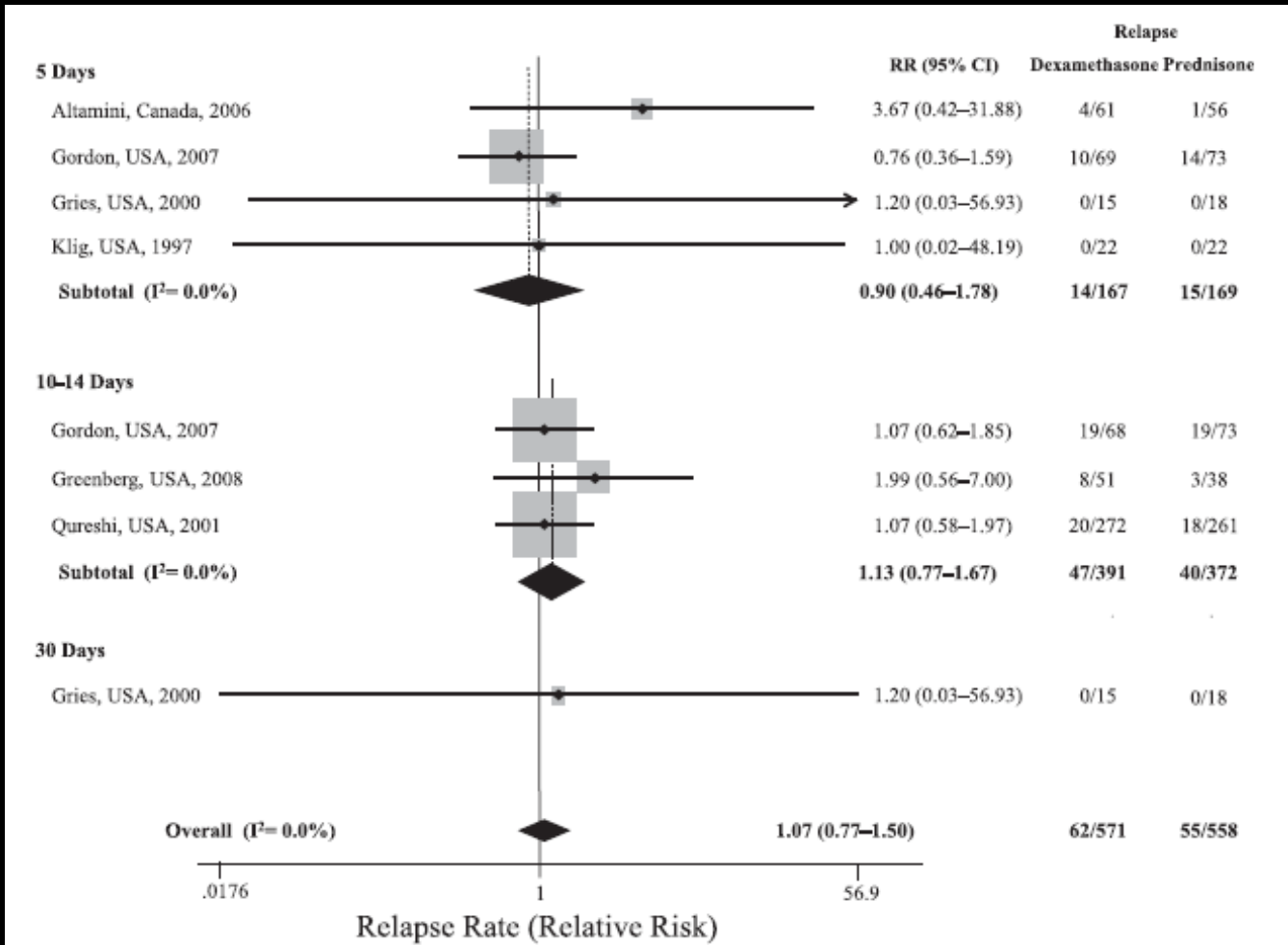
IQR, interquartile range; OR, odds ratio.

<sup>a</sup> Median time to clinical improvement before and after implementation was computed and 95% CIs for differences were obtained

<sup>b</sup> Adjusted for preceding URTI and use of salbutamol, oral montelukast, chronic inhaled corticosteroids, and for previous ICU admission using logistic regression. Time to events was compared between phases by using Cox proportional hazards regression.



# Dexamethasone vs. prednisone for asthma meta-analysis



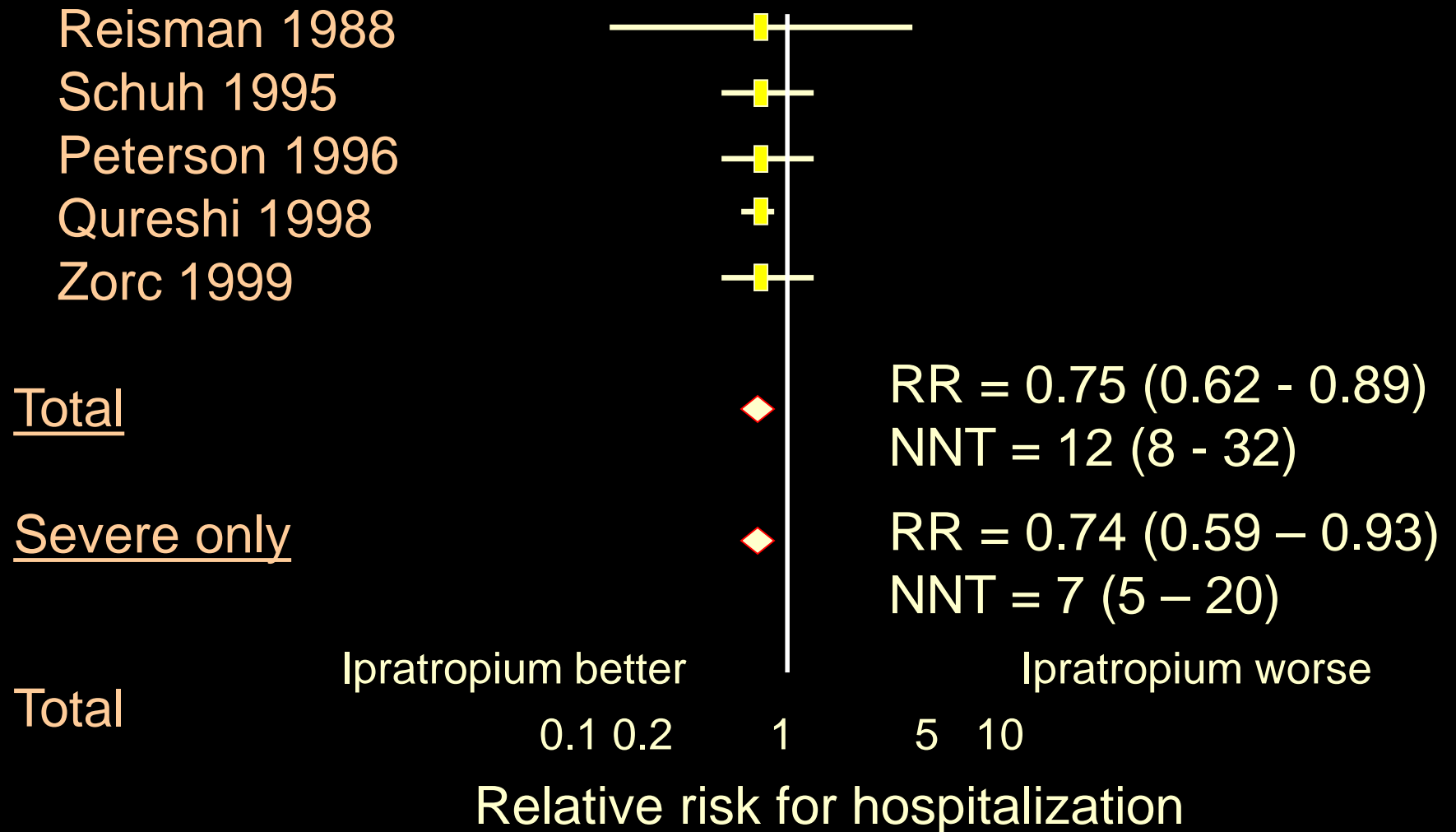
## Relapse to ED

RR 1.07,  
95% CI 0.77–1.50

## Vomiting in ED

RR 0.29,  
95% CI 0.12–0.69

## Ipratropium: Cochrane meta-analysis





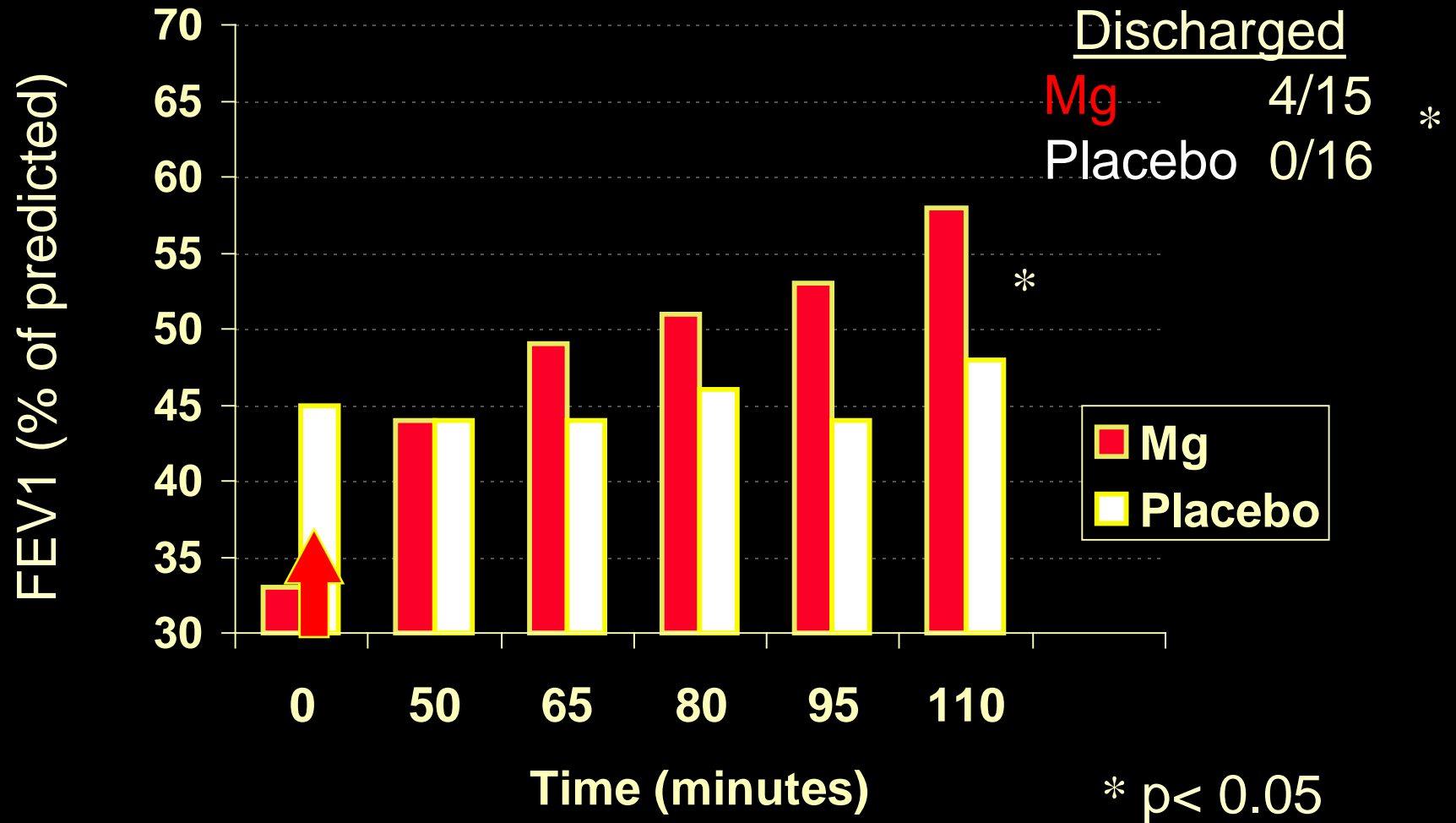
## Magnesium

Ciarallo et al, 1996

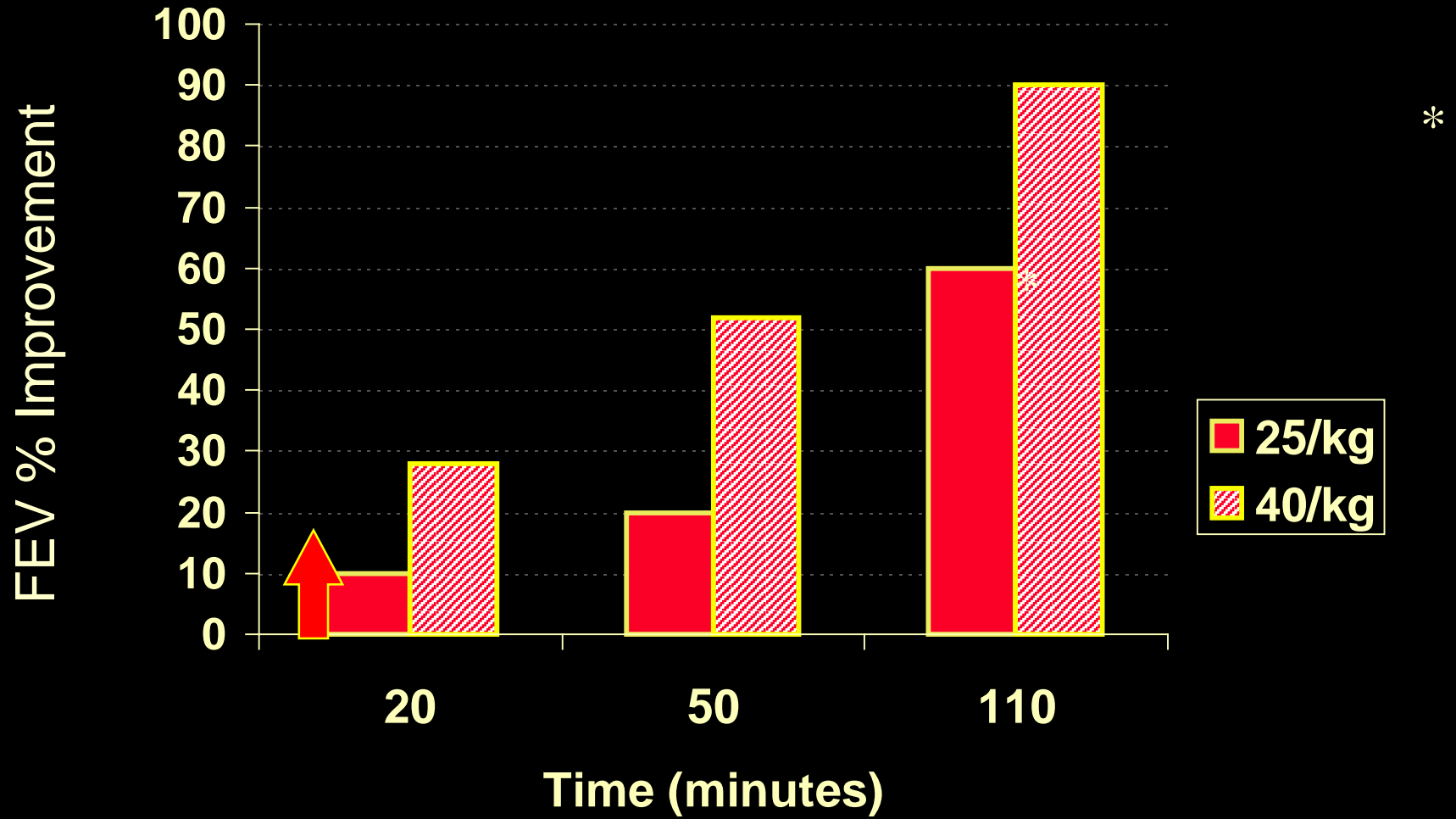
- Eligibility:
  - 31 children age 6-18 yrs
  - PEFr < 60% predicted after 3 doses albuterol
- Intervention:
  - All received corticosteroids
  - Randomized to MgSO<sub>4</sub> (25/kg, max. 2g) IV vs. NS
- Outcomes:
  - FEV<sub>1</sub>, peak flow
  - ED disposition

# Magnesium

Effect on pulmonary function: *Ciarallo et al., 1996*



Higher dose magnesium: *Ciarallo et al., 2000*



## Magnesium Summary

- Mentioned in NHLBI Guidelines as a rescue medication
- Should we be using IV Mg more regularly?
  - Survey: Concerns about adverse effects, monitoring, IV  
*Schuh et al. Acad Emerg Med 2010*
  - PECARN Registry: Low use, no increased revisits after discharge  
*Johnson et al. PAS Meeting 2017*
- Nebulized Mg:
  - MAGNETIC study - *Powell et al. Health Tech Assess 2013*
    - Multicenter study of 508 children in the United Kingdom
    - Randomized to Mg/NS given with albuterol / ipratropium x 3
    - 1 hour score: Clinically insignificant improvement in Mg group
  - Ongoing Canadian study (MagNUM PA): Nebulized Mg as rescue

## Top 5 Reasons to Become an EM Researcher

2. Collaborate in research networks
3. Travel and meet colleagues around the world
4. Build a career in academic medicine
5. New opportunities to translate evidence effectively

# Corticosteroids



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### A Multicenter, Randomized, Controlled Trial of Dexamethasone for Bronchiolitis

Howard M. Corneli, M.D., Joseph J. Zorc, M.D., Prashant Majahan, M.D., M.P.H., Kathy N. Shaw, M.D., M.S.C.E., Richard Holubkov, Ph.D., Scott D. Reeves, M.D., Richard M. Ruddy, M.D., Baqir Malik, M.D., Kyle A. Nelson, M.D., M.P.H., Joan S. Bregstein, M.D., Kathleen M. Brown, M.D., Matthew N. Denenberg, M.D., Kathleen A. Lillis, M.D., Lynn Babcock Cimpello, M.D., James W. Tsung, M.D., Dominic A. Borgialli, D.O., M.P.H., Marc N. Baskin, M.D., Getachew Teshome, M.D., M.P.H., Mitchell A. Goldstein, M.D., David Monroe, M.D., J. Michael Dean, M.D., and Nathan Kuppermann, M.D., M.P.H., for the Bronchiolitis Study Group of the Pediatric Emergency Care Applied Research Network (PECARN)\*

- Multicenter randomized trial of infants with bronchiolitis
- 600 infants < 12 months with 1<sup>st</sup> episode wheeze
- RDAI score  $\geq 6$  (maximum of 17)
- Randomized to one dose oral dexamethasone vs. placebo
- Respiratory treatments per MD discretion: 80% albuterol / 15% epi

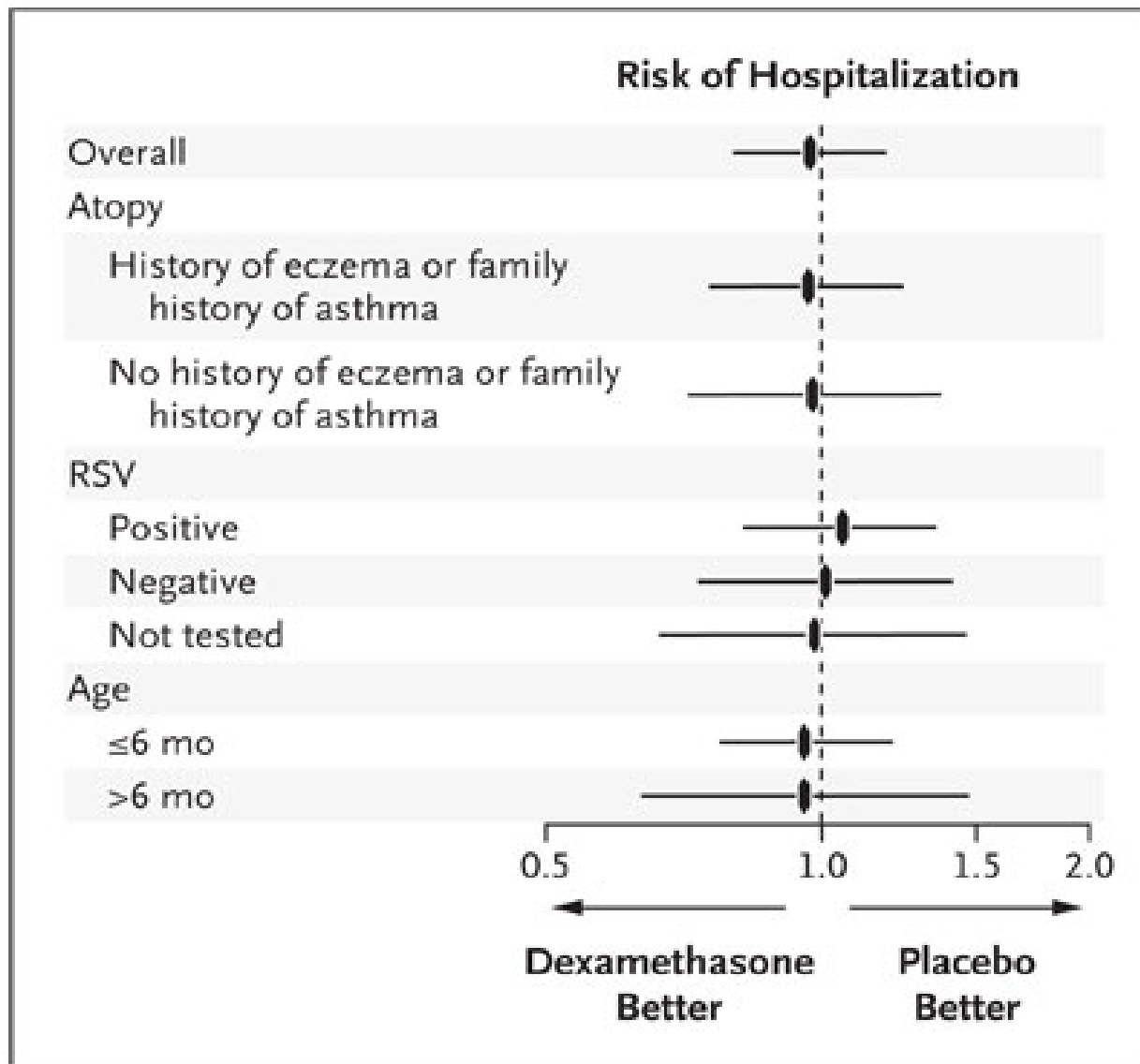
### Results

- No difference in hospitalization or severity score between groups

*Corneli et al. NEJM 2009*



# Subgroup Analysis





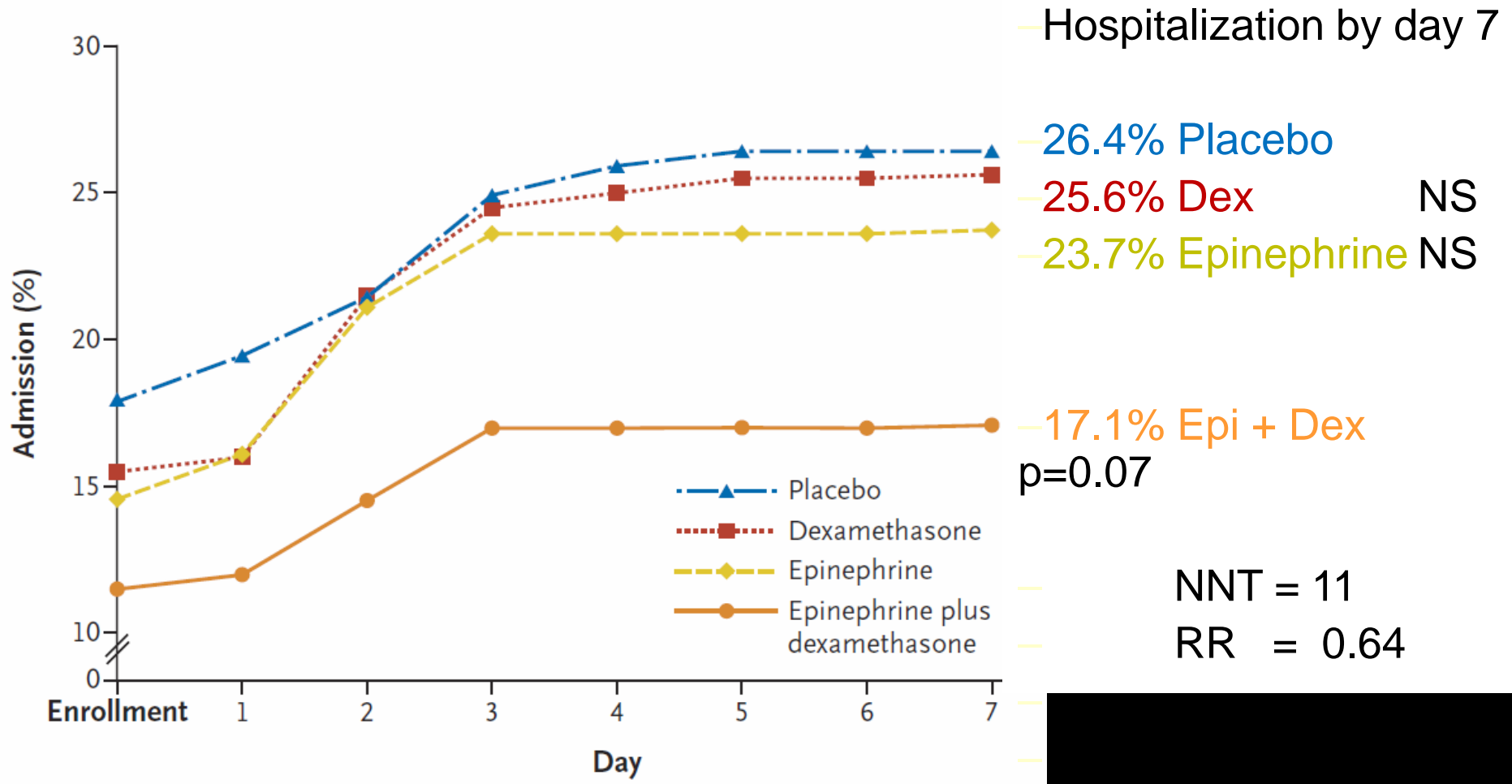
## Epinephrine and Dexamethasone in Children with Bronchiolitis

Amy C. Plint, M.D., M.Sc., David W. Johnson, M.D., Hema Patel, M.D., M.Sc.,  
Natasha Wiebe, M.Math., Rhonda Correll, H.B.Sc.N., Rollin Brant, Ph.D.,  
Craig Mitton, Ph.D., Serge Gouin, M.D., Maala Bhatt, M.D., M.Sc.,  
Gary Joubert, M.D., Karen J.L. Black, M.D., M.Sc., Troy Turner, M.D.,  
Sandra Whitehouse, M.D., and Terry P. Klassen, M.D., M.Sc.,  
for Pediatric Emergency Research Canada (PERC)

- Multicenter randomized trial of infants with bronchiolitis
- 800 infants < 12 months with 1<sup>st</sup> episode wheeze
- RDAI score  $\geq 4$  (maximum of 17)
- Randomized to 4 groups:
  - Nebulized Saline / Oral Placebo
  - Nebulized Epinephrine / Oral Placebo
  - Nebulized Saline / Oral Dexamethasone
  - Nebulized Epinephrine / Oral Dexamethasone

*Plint et al. for PERC, New Engl J Med 2009*

# Admission by day



# Practice Variation in Acute Bronchiolitis: A Pediatric Emergency Research Networks (PERN) Study

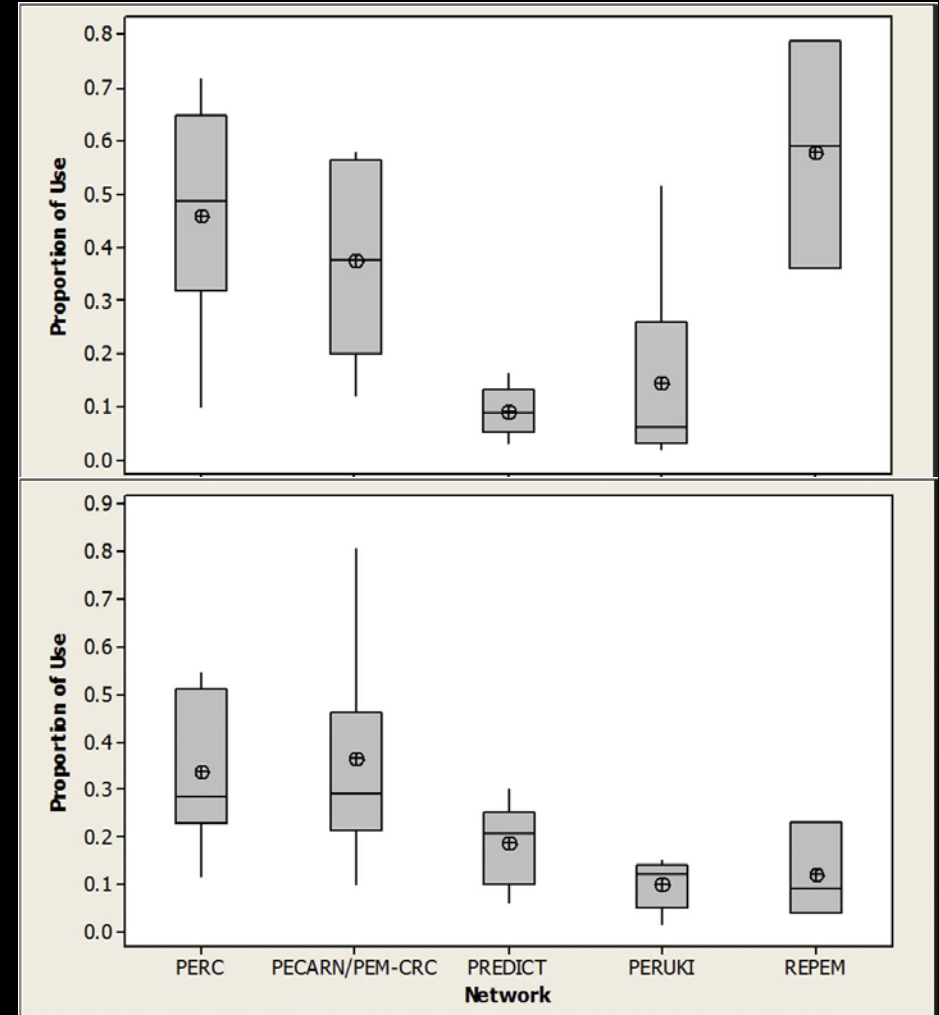
Suzanne Schuh and TNTC others

## Variation Across Global Networks

Pharmacotherapy



Chest Radiography



# Chest radiography

*Schuh et al., J Pediatrics 2007*

Prospectively studied 265 infants 2-23 mos. w/ bronchiolitis

- Defined “typical bronchiolitis”
  - Non-toxic appearance, cold symptoms, cough, 1<sup>st</sup> wheeze
  - Excluded children with chronic disease, prematurity, OM
- All received chest radiographs, reviewed by 2 radiologists
- Asked ED MD about antibiotic treatment pre/post X-ray
- Results:
  - Routine CXR no benefit (2 incidental findings, ? 1 “lobar”)
  - 1 extra antibiotic course for every 9 CXRs

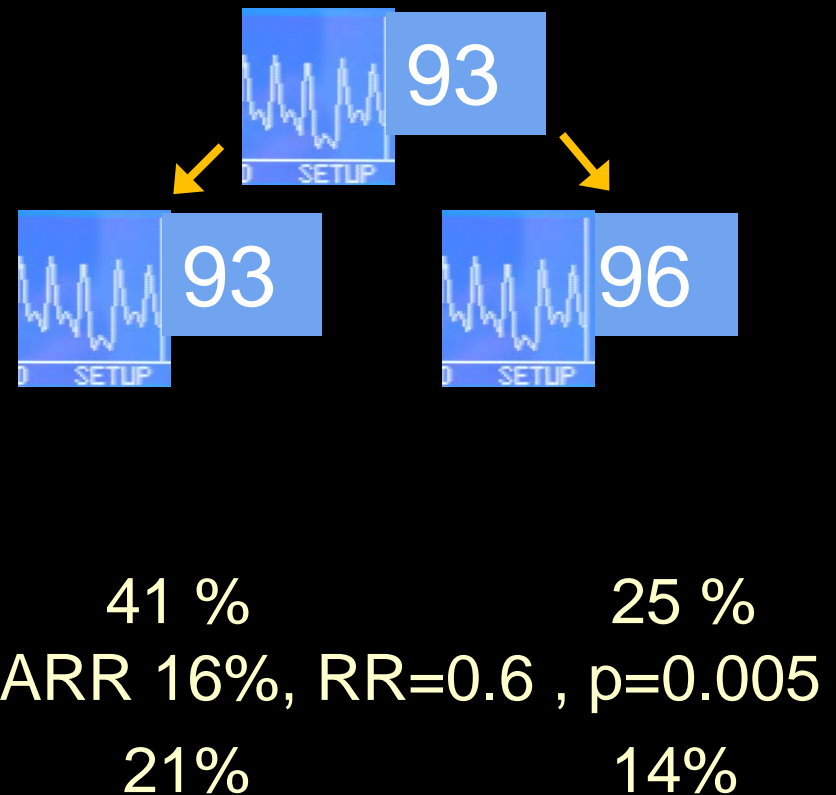
## Mild hypoxemia in the ED: *Schuh et al. JAMA 2014*

RCT of previously healthy infants at Toronto Sick Kids

- 4 weeks – 12 months old
- Mild-moderate bronchiolitis
- Oxygen sat  $\geq 88\%$
- Randomized after triage
- Intervention: pulse ox  $\uparrow 3\%$

### Outcomes

- Admission rate
- Revisits



## Hypoxemia after ED discharge

- Prospective cohort: 118 infants after ED d/c for bronchiolitis
- Oxygen saturation measured with blinded pulse oximeter
- Measured desaturations at home lasting > 1 minute:
  - 64% had  $\geq 1$  desaturation < 90%
  - 50% had  $\geq 1$  desaturation < 80%
  - 24% had  $\geq 1$  desaturation < 70%
  - Median desaturation lasted 3 minutes 22 seconds
- Infants with desaturation had similar outcomes to those w/o:
  - Unscheduled medical visits: 24% vs 26%
  - Hospitalization: 1% vs 5%

*Principi et al. JAMA Pediatr 2016*

## High-flow nasal cannula oxygen



### High-flow warm humidified oxygen versus standard low-flow nasal cannula oxygen for moderate bronchiolitis (HFWHO RCT): an open, phase 4, randomised controlled trial

Elizabeth Kepreotes, Bruce Whitehead, John Attia, Christopher Oldmeadow, Adam Collison, Andrew Searles, Bernadette Goddard, Jodi Hilton, Mark Lee, Joerg Mattes

- Australian single center RCT:
  - 202 children 0-24 mos. with moderate bronchiolitis
  - Reduced treatment failure with HFNC: 33% vs 14%
  - 61% of failures on standard O<sub>2</sub> rescued with HFNC
  - No difference in ICU transfer rates: 12% vs 14%
  - No difference in hospital LOS

*Kepreotes et al. Lancet 2017*



## HFNC Multi-center



Paediatric Research in  
Emergency Departments  
International Collaborative

### A Randomized Trial of High-Flow Oxygen Therapy in Infants with Bronchiolitis

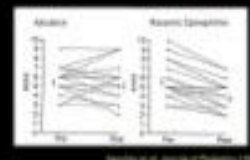
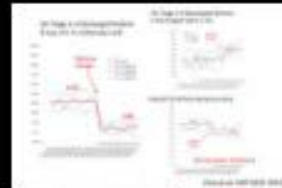
Donna Franklin, B.N., M.B.A., Franz E. Babl, M.D., M.P.H.,  
Luregn J. Schlapbach, M.D., Ed Oakley, M.B., B.S.,  
Simon Craig, M.B., B.S., M.H.P.E., M.P.H., Jocelyn Neutze, M.B., Ch.B.,  
Jeremy Furyk, M.B., B.S., M.P.H.&T.M., John F. Fraser, M.B., Ch.B., Ph.D.,  
Mark Jones, Ph.D., Jennifer A. Whitty, B.Pharm., Grad.Dip.Clin.Pharm., Ph.D.,  
Stuart R. Dalziel, M.B., Ch.B., Ph.D., and Andreas Schibler, M.D.

- PREDICT Network multi-center RCT:
  - 1,472 children < 12 months with bronchiolitis requiring O<sub>2</sub>
  - HFNC 2 L/kg/min vs. standard 0-2 L/min oxygen
  - Reduced escalation with HFNC: 23% vs. 12%, NNT 9
  - 61% of failures on standard O<sub>2</sub> rescued with HFNC
  - No difference in ICU transfer rates: 9% vs 12%
  - No difference in hospital LOS

*Franklin et al. NEJM 2018*

## Top 5 Reasons to Become an EM Researcher

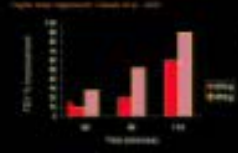
1. Impact patients and improve care
2. Collaborate in research networks
3. Travel and meet colleagues around the world
4. Build a career in academic medicine
5. New opportunities to translate evidence effectively



A slide containing a table with several rows and columns of data. Below the table is a photograph of a woman with dark hair, looking towards the camera.

A table with multiple columns and rows of data, likely representing clinical trial results or patient statistics. The text is small and difficult to read.

A table with multiple columns and rows of data, similar to the previous table, containing numerical values and possibly percentages.



A slide with a list of bullet points. The text is small and difficult to read. There is a small diagram or chart at the bottom right of the slide.

A slide with the text 'NICE Guidelines' at the top and 'BRONCHIOLITIS' in large letters at the bottom. There is a small graphic of a red cross.

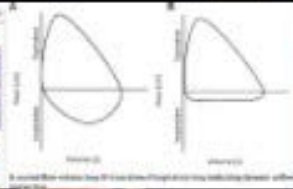
A slide with a photograph of a dog on the left and a photograph of a woman on the right. There is some text between the images, but it is too small to read.



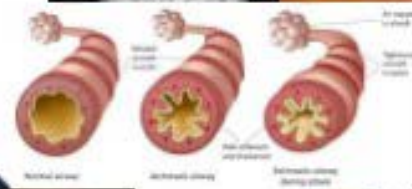
A slide with a photograph of a dog on the left and a photograph of a woman on the right. There is some text between the images, but it is too small to read.



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A slide containing a table with several rows and columns of data. Below the table is a photograph of a woman with dark hair, looking towards the camera.



A slide with a photograph of a baby on the left and a list of bullet points on the right. The text is small and difficult to read.

A slide with the word 'PEDIATRICS' in large letters at the top and a list of bullet points below. The text is small and difficult to read.



A table with multiple columns and rows of data, likely representing clinical trial results or patient statistics. The text is small and difficult to read.



## Bronchiolitis



### Initial Management

Suctioning

Repeat assessments

Routine care:

No CXR or viral test

No bronchodilators

### Severe Disease

HFNC Oxygen

Epinephrine

## Asthma



Early steroids

Severity assessment

Mild-moderate: MDI

Severe:

Continuous albuterol

Ipratropium

IV Magnesium