## Viewing Time

The program will take up to one hour to complete.

## Target Audience

This program is designed for primary care physicians.

Other health care professionals working with patients and their families may also find this program of interest.

## Faculty Disclosure

It is the policy of Children's Hospitals and Clinics of Minnesota to ensure balance, independence, objectivity, and scientific rigor in all its educational programs. Our faculty have been asked to disclose to our program audience any real or apparent conflicts of interest related to the content of their presentation. They have also been requested to let you know when any product mentioned in their presentation is not labeled for the use under discussion or is still under investigation.

## Faculty Disclosure

**Stanley Weinberger, MD,** has disclosed no actual or potential conflict of interest in relation to this educational activity.

During this educational activity **Dr. Weinberger** will not be discussing the use of any commercial or investigational product not approved for any purpose by the FDA.

## Case Presentation: "11-month-old with respiratory distress"

**Stanley Weinberger , MD**
Chief Resident, Department of Pediatrics, University of Minnesota, Minneapolis, Minnesota

## Case Presentation: "11-month-old with respiratory distress"

*A case presentation about a 11-month-old boy brought to the emergency department with wheezing.*

## Program Objectives

***Upon completion of this program, participants should be able to:***

- Inform participants of unusual presentations of common pediatric problems
- Identify specific difficulties in the diagnosis of specific problems
- Discuss potential difficulties in the management of pediatric problems

## Disclaimer

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## Accreditation

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## Receiving CME Credit

To receive CME credit you must view the entire program and complete the evaluation form at the end.

**Children's Hospitals & Clinics of Minnesota Grand Rounds**

11 month old male with respiratory distress

Stanley Weinberger
Pediatric Chief Resident
February 5th, 2009

## In the Emergency Department

Triage: 11 mo male with wheezing

- T 38.2 P 160 RR 48 O2 96%

24 hours 48 hours

## History of Present Illness

Difficulty breathing over last 2 days; worse in last 24 hours. Also cough, low-grade fever, and irritability. Albuterol x 4 today with no improvement.

- **ROS**: no nausea or vomiting; decreased activity.
- **PMHx**: RAD in past
- **SocHx**: Somali family, 2 siblings
- **FamHx**: sibling with asthma (worse than patient)

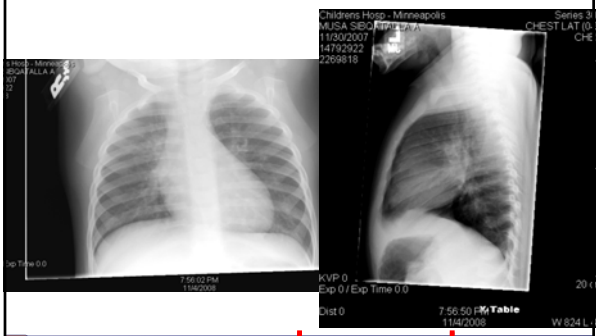
24 hours 48 hours

## Exam

- T 38.2 P 160 RR 48 O2 96% RA
- Gen: well-developed, anxious, and unhappy with exam, crying easily. Not in acute distress
- HEENT: clear
- Pulm:
  - Suprasternal and abdominal retractions
  - variable exam, showing better, than worse air movement, with crackles and wheezes, depending on when listening.

24 hours 48 hours

## Chest Xray



1 hour 24 hours 48 hours

## ED Course

**Labs**: WBC 15.7 (60N, 4 bands, 27L), BMP nl
RSV Ag neg, pertussis DFA pending
CBG 7.39/31/18/ BE -6
Duonebs in ED with some response. Oral steroids started.

**Assessment**: RAD, likely secondary to viral illness

**Plan**: Admit and follow in short stay unit

2 hours 24 hours 48 hours

## Short Stay Unit

## Short Stay Literature- Cooke et al.

Distinguish between observation (<24 hrs), short stay (24-72hrs), and Hybrid units

- Common (59% of ED's in UK; 27% in US)
- Perceived to be safe and efficient
  - Hadden et al found decreased length of stay.
  - Rydman et al found improved patient satisfaction.
- Widely reported to produce savings
  - Interpret with caution – not formal cost effectiveness analysis.

Cooke et al. "Use of emergency observation and assessment wards: a systematic literature review." Emergency Medicine Journal. 2003

## Short Stay Literature – Zebrack et al

Retrospective review of a US pediatric hybrid unit
- 65% observation pts; 35% procedure pts
- 15% required subsequent admission
  - Most likely: hematochezia (60%)
    viral pneumonia (46%)
    bronchiolitis (43%) – assoc with age
    *asthma (22%)*
  - Successfully treated in observation unit:
    neonatal hyperbili, aseptic meningitis, DKA*

Zebrack et al. "The pediatric hybrid observation unit: an analysis of 6477 consecutive patient encounters." Pediatrics. 2005

## Short Stay Structure

- Minneapolis Children's: Hybrid Observation Unit
  - 16 beds (8 at night; 2 nurses)
  - ED staffs, until primary team can take over
- UMCH Hybrid Observation Unit
  - Coming to a hospital near you …
- Ideal Ward - Cooke
  - Should be time limited (24 hours)
  - Staffed by senior personnel
  - Strong procedures (especially for transfer out) are important.
  - *Intelligence in who you admit*

## Admission H&P

- **HPI**: 11mo male dry cough, nasal congestion, no wheezing, but increased WOB. Improved with neb. Older sib with mild resp symptoms. Tactile temp. Emesis x 1 (seems post-tussive).
- **ROS**: decreased po today, normal wet diapers.
- **PMHx**: 1 previous episode of wheezing @ 5mo; term baby, no complications; eczema
- **SocHx**: mom, dad, 2 sibs, no pets, no tobacco.
- **FamHx**: 1 older brother with asthma

3 hours | 24 hours | 48 hours

## Admit exam

- T 37.1 P 142 RR 40 O2 94% RA
- Gen: sleeping in mom's lap
- Pulm: mild intercostal retractions, no nasal flaring, good airflow with end-exp wheezes bilaterally, symmetric
- CRP 0.8 mg/dl (added to labs)

3 hours | 24 hours | 48 hours

## Admit Assessment

- Viral-induced RAD and mild dehydration

**Plan**
- Asthma pathway: po steroids, albuterol q2hr
- Continous pulse ox
- Maintenance IVF (D5 ½ NS + 10KCl @ 50ml/hr); Consider resuming po if patient improves

3 hours | 24 hours | 48 hours

## Short Stay Unit Course

- **02:00** – T 36.6 P152 RR 56 O2 92% RA

5 hours | 24 hours | 48 hours

## Short Stay Unit Course

- **02:00** – T 36.6 P152 RR 56 O2 92% RA
- **04:00** – P 152 RR 48 O2 92% BB (90% RA)
- MD assessment: increased WOB, with increased retractions and wheezing in all fields

7 hours 24 hours 48 hours

## Short Stay Unit Course

- **02:00** – T 36.6 P152 RR 56 O2 92% RA
- **04:00** – P 152 RR 48 O2 92% BB (90% RA)
- MD assessment: increased WOB, with increased retractions, increasing wheezing in all fields

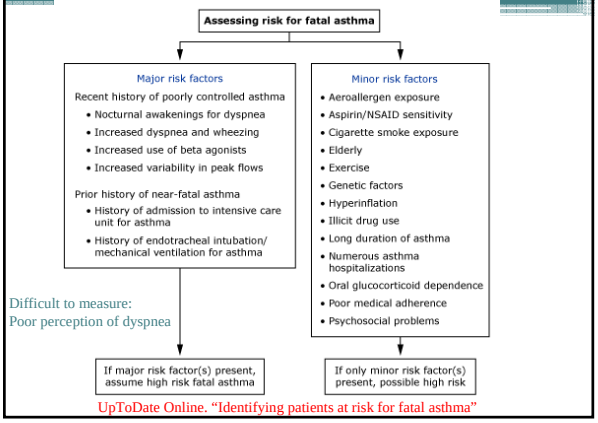
•CBG: 7.33/38/18/ BE -7
•Levalbuterol neb given; HFNC @ 6L started
•Bed control called: no beds available

7 hours 24 hours 48 hours

## Severe Asthma

- "Any acute exacerbation of asthma may be a potentially fatal attack"
  - As many as 1/3 of children who die were not previously classified as being at risk for fatal asthma
- Slow onset fatal asthma:
  - 85% have symptoms for >12 hours (often weeks) with inflammation
- Rapid onset fatal asthma:
  - Up to 20% have death in 2 to 6 hours, with severe airway obstruction/bronchospasm

UpToDate Online. "Identifying patients at risk for fatal asthma"




UpToDate Online. "Identifying patients at risk for fatal asthma"

## Short Stay Unit Course Continued

- **05:00** - P 156 RR 48
  O2 98% on HFNC @ 6 lpm/ FiO2 50%
  Somewhat improved after levalbuterol working on bed availability

8 hours 24 hours 48 hours

## Short Stay Unit Course Continued

- **05:00** - P 156 RR 48
  O2 98% on HFNC @ 6 lpm/ FiO2 50%
  Somewhat improved after levalbuterol working on bed availability
- **06:15** – RR 60 P 164
  O2 98% now on HFNC 8 lpm/ FiO2 100%
- MD assessment: working harder with severe retractions; slight improvement with epi neb, but significant distress

9 hours 24 hours 48 hours

## Short Stay Unit Course Continued

- **05:00** - P 156 RR 48
  O2 98% on HFNC @ 6 lpm/ FiO2 50%
  Some … buterol
  worki…
- **06:15** – …
  O2 98… O2 100%
- MD assessment: working harder with severe retractions. Slight improvement with Epi neb, but significant distress.

What Now??

9 hours | 24 hours | 48 hours

## Short Stay Unit Course Continued

- **05:00** - P 156 RR 48
  O2 98% on HFNC @ 6 lpm/ FiO2 50%
  Some … buterol
  worki…
- **06:15** – …
  O2 98… O2 100%
- MD assessment: working harder with severe retractions. Slight improvement with Epi neb, but significant distress.

What Now??
Ward & PICU full …

9 hours | 24 hours | 48 hours

## Management of severe asthma

- Medical therapies (preintubation):
  - Continuous albuterol
  - Methylprednisolone IV
  - Ipratropium bromide
  - Magnesium sulfate IV
- If failing, may use IV bronchodilator (terbutaline or aminophylline)
- Noninvasive positive pressure ventilation
- Endotracheal intubation
  - Strategies: decrease I:E ratio, small vol, permissive hypercapnia

UpToDate Online. "ICU management of severe asthma exacerbation in children."

## Lessons from hospital experience

Unpublished review of pediatric asthma cases requiring intubation over 3 years

- Most were intubated within 4 hours of arrival
- 75% had not received po steroids prior to hosp (remainder received one dose)
- Mean $PCO_2$ prior to intubation was 38
  - Intubation was based on clinical grounds

## Back to the ED stabilization room

- **7:10** – P 191 RR 31
  O2 99% on HFNC 8L/ FiO2 100%
  tight wheezing retractions, dusky
- 12 nebs so far (8 albuterol, 2 atrovent, 2 epi)
- VBG: 7.27/45/36/20/BE -6
- BMP nl, Lactate 9 mg/dl

10 hours | 24 hours | 48 hours

## Back to the ED stabilization room

- **7:10** – P 191 RR 31
  O2 99% on HFNC 8L/ FiO2 100%
  tight wheezing retractions, dusky
- 12 nebs so far (8 albuterol, 2 atrovent, 2 epi)
- VBG: 7.27/45/36/20/BE -6
- BMP nl, Lactate 9 mg/dl

- **8:15** – Intubated successfully

11 hours | 24 hours | 48 hours

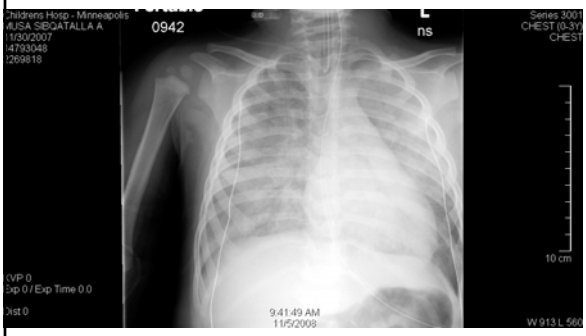
## Post-intubation CXR – 8:30 am

## No PICU beds available - Transfer

- Stable blood pressures, pulse ox and ETCO2
- After 5 min in ambulance on vent decompensated with decreasing O2 sats
  → **Return to ED**
- O2 80% on FiO2 100%, poor chest rise
- Frothy tracheal secretions
- ABG 7.18/69/66/25

12 hours 24 hours 48 hours

## Chest Xray - 9:45 am



## In the PICU – More Data

**Vitals**: P 180s RR 23 O2 87 – 91%
BP 96/42→ 75/32 (art line) CVP 4-7
**Exam**: lungs with crackles in LLL, diminished in RLL, suction pink frothy sputum

- ABG: 7.19/56/69/21 91%
- VBG: 7.17/68/44/24 66% on 100% FiO2
- WBC 14.9 (79N, 17L), Hgb 11.6, Plt 443
- BMP nl, alb 2.7/TP 5.1, Lactate nl
- Bili and transaminases nl, coags nl, CBC nl
- Blood cx pending

13 hours 24 hours 48 hours

## In the PICU

- **Assessment**: Acute respiratory failure, with florid pulmonary edema; probable sepsis
- **Plan**
  - Central venous and arterial access
  - Pressure Control Ventilation
  - Dopamine and Milrinone started
  - Diuretics
  - Broad spectrum antibiotics

14 hours 24 hours 48 hours

## In the PICU

- **Assessment**: Acute respiratory failure, with florid pulmonary edema; probable sepsis
- **P**

**Differential Diagnosis:**
Sepsis with ARDS
Severe asthma
Severe pneumonia
Cardiomyopathy or other heart failure
???

14 hours 24 hours 48 hours

## Echocardiogram

Two Echo's done in rapid succession

**First**: 9:45 am

- Nl anatomy, nl ventricular size and function

**Second**: 11:30 am

- Mildly enlarged LV, mild to mod decreased global LV function
- Abnormal intraventricular septal motion (hypokinetic)

## To the brink …

- Trial of oscillation
  - unable to raise oxygen saturations
  - significantly hypotensive despite inotropic support
- Labs: CRP 10.5, Lactate 15, D-dimer > 1,000 amylase/lipase nl, cortisol 81.3

14 hours 24 hours 48 hours

## To the brink …

- Trial of oscillation
  - unable to raise oxygen saturations
  - significantly hypotensive despite inotropic support
- Labs: CRP 10.5, Lactate 15, D-dimer > 1,000 amylase/lipase nl, cortisol 81.3
- **ECMO primed**

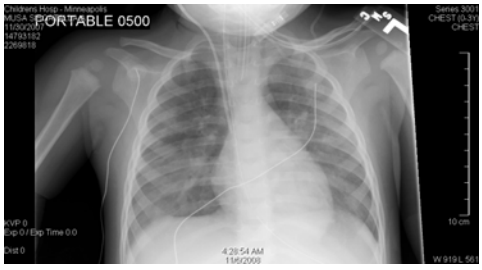
15 hours 24 hours 48 hours

## To the brink …

- Trial of oscillation
  - unable to raise oxygen saturations
  - significantly hypotensive despite inotropic support
- Labs: CRP 10.5, Lactate 15, D-dimer > 1,000 amylase/lipase nl, cortisol 81.3
- ECMO primed
- Aggressive pulmonary toilet, vasopressin started and volume given with some improvement of compliance
- Aggressive diuresis with continued improvement and ECMO canceled

16 hours 24 hours 48 hours

## Chest xray – Next day




24 hours 36 hours 48 hours

## And back - the next day

- T 37.5 P160 BP 97/39 CVP 6 uo good
- O2 100% on 75% FiO2, PEEP 5
- **Exam**: lungs clear, no murmur, warm and well perfused, good pulses
- **Labs**: CRP 5.5, Alb 3.8, Lactate 8, no evidence of coagulopathy overnight
- Blood and urine cultures negative
- Nose cx MSSA
- Begin weaning vent and dopamine (still on milrinone)

## Negative Pressure Pulmonary Edema

$Q = K_f (P_c - P_i) - \sigma (\pi_c - \pi_i)$

**Components**

1. Negative Pleural Pressure and loss of "auto-PEEP"
   - Argent et al. Showed that minute ventilation is maintained in croup by "huge increases in intrathoracic pressure changes"
2. Cardiorespiratory interactions and increased pulmonary capillary pressure
3. Pulmonary capillary permeability ("stress failure")

**When**: Acute obstruction (croup, post-extub laryngeal edema, FB), relief of obstruction (post-T&A)

Thiagarajan et al. "Negative pressure pulmonary edema in children: pathogenesis and clinical management." Pediatric Anesthesia. 2007

## Negative Pressure Pulmonary Edema

$Q = K_f (P_c - P_i) - \sigma (\pi_c - \pi_i)$

**Therapy**

1. Supportive Therapy
2. PEEP
3. Diuretics and steroids frequently used

(efficacy questionable)

**When**: Acute obstruction (croup, post-extub laryngeal edema, FB), relief of obstruction (post-T&A)

Thiagarajan et al. "Negative pressure pulmonary edema in children: pathogenesis and clinical management." Pediatric Anesthesia. 2007

## Hospital Course

- Day 3 – Inotropes weaned off
- Day 5 - Extubated
- Day 6 - Transferred to floor and weaned off O2

- Pulmonary consult felt this was consistent with status asthmaticus with florid negative pressure pulmonary edema
- All bacterial and viral cultures remained negative
- Discharged home with asthma action plan

## Did he have asthma?

- **NHLBI**: diagnosis in <5yo is "challenging"

**Possible Clinical Index**

| Major Criteria | Minor Criteria |
|---|---|
| 1. Parental asthma | 1. MD allergic rhinitis |
| 2. MD eczema | 2. Wheezing apart from colds |
| | 3. Eosinophila (>4%) |

Stringent = frequent wheezing during 1st 3 years + 1 major or 2 minor

Loose = any wheezing during 1st 3 years + same as above

Castro-Rodriguez et al. "A clinical index to define risk of asthma in young children with recurrent wheezing." American Journal of Critical Care Medicine. 2000

## Did he have asthma?

- Our Child:
  - PMHx: 1 previous ED visit for wheezing (got albuterol), 2 other bouts, all with URI's
  - Pt also with eczema
  - FamHx: Brother with food allergies and asthma; sister with eczema; Many other family with asthma
  - Father smokes outside, no pets, No carpet/mold exposure, but possible mice exposure
- He would meet stringent criteria

## What can we learn?

- Know your systems and their capabilities
- Any acute exacerbation of asthma may be a potentially fatal attack
  - Ask about poorly controlled asthma, poor perception of dyspnea and past history of near-fatal asthma
- Intubation is based on clinical grounds
- Negative pressure pulmonary edema is a rare but potentially fatal complication
- Consider clinical criteria when questioning asthma in young children

**Comments**
**and**
**Questions**

***Thanks for viewing this presentation!***

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# Sources


- Cooke et al. “Use of emergency observation and assessment wards: a systematic literature review.” Emergency Medicine Journal. 2003; 20: 138-42.
- Hadden et al. “Short stay observation patients: general wards are inappropriate.” J Accid Emerg Med. 1996; 13: 163-5.
- Rydman et al. “Patient satisfaction with an emergency department asthma observation unit.” Academic Emergency Medicine. 1999; 6: 178-83
- Howell JD. “ICU management of acute severe asthma exacerbation in children.” UpToDate Online. 2008.
- Madison, Irwin. “Identifying patients at risk for fatal asthma.” UpToDate Online. 2008.
- Stalcup, Mellins. “Mechanical forces producing pulmonary edema in acute asthma.” New England Journal of Medicine. 1977; 297(11):592-96
- Thiagarajan, Laussen. “Negative pressure pulmonary edema in children: pathogenesis and clinical management.” Pediatric Anesthesia. 2007; 17: 307-10
- Argent et al. “The mechanics of breathing in children with acute severe croup.” Intensive Care Medicine. 2008; 34: 324-32.
- Sawiki et al. “Evaluation and diagnosis of chronic asthma in children younger than 12 years.” UpToDate Online. 2008
- Castro-Rodriguez et al. “A clinical index to define risk of asthma in young children with recurrent wheezing.” American Journal of Critical Care Medicine. 2000; 162: 1403-06.
- “Guidelines for the diagnosis and management of asthma: summary report 2007.” National Asthma Education and Prevention Program Expert Panel Report 3. NHLBI.
- Zebrack et al. “The pediatric hybrid observation unit: an analysis of 6477 consecutive patient encounters.” Pediatrics. 2005; 115: 535-42