

NONINVASIVE RESPIRATORY SUPPORT FOR COMMON PEDIATRIC ILLNESSES

North Central Regional Trauma Advisory Council

Trauma Conference 2017

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The Plaza Hotel & Suites, Wausau

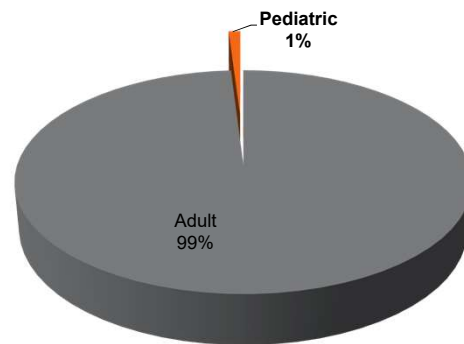
5/5/17



INTRODUCTION
BEGIN AT THE VERY BEGINNING

WHY IS THIS IMPORTANT?

Boston EMS Patient Transports 2001



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Boston EMS Patient Transports 2001

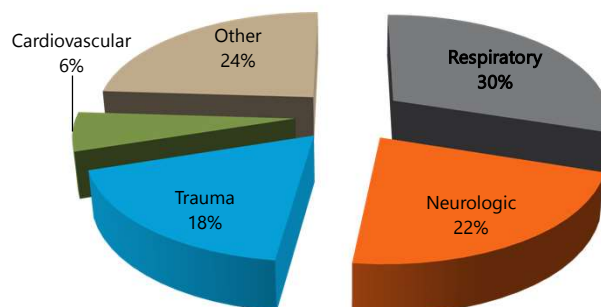
130K dispatches, 59K patient transports

555 pediatric transports by 50 providers

- 1 pediatric BVM every 1.7 years
- 1 pediatric intubation every 3.3 years
- 1 interosseous access every 6.7 years
- 1 Pediatric defibrillation every 20.1 years

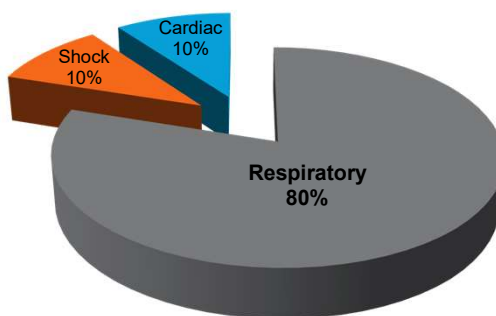
WHY IS THIS IMPORTANT?

Indications for Pediatric Transport



WHY IS THIS IMPORTANT?

Pediatric Cardiopulmonary Arrests



STATISTICS

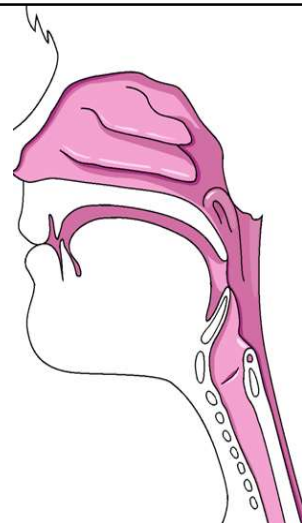
1. Trauma is the leading cause of pediatric death and morbidity.
 1. Motor vehicle collisions
 2. Suicide and homicide
 3. Drowning
 4. Nonaccidental trauma
2. Thoracic trauma is the second-leading cause of death in pediatric trauma patients, occurring in 5% of hospitalizations.

THE PEDIATRIC AIRWAY

The Nose

50% of airway resistance
at all ages

Infants are obligate
nose breathers.

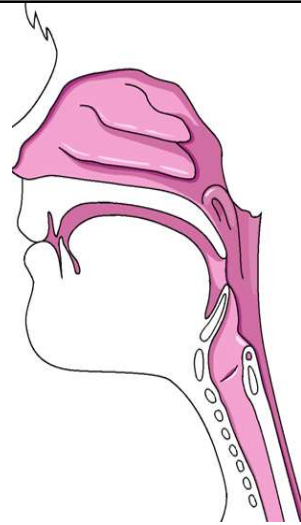


THE PEDIATRIC AIRWAY

The Tongue

Large, posterior

Loss of tone with sleep and
neurologic dysfunction

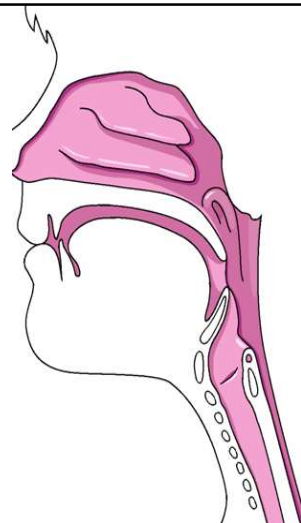


THE PEDIATRIC AIRWAY

The Larynx

Cephalad (C1 vs C6)

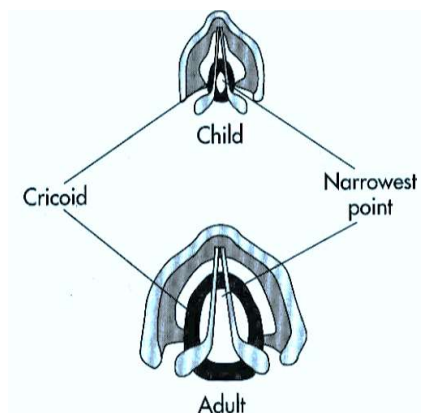
Anterior



THE PEDIATRIC AIRWAY

The Larynx

Conically shaped

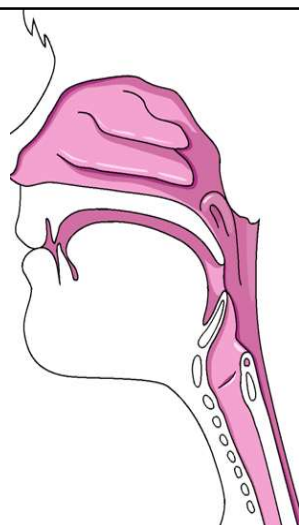


THE PEDIATRIC AIRWAY

The Epiglottis

Large

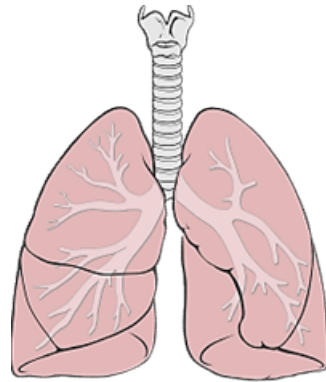
Lacks cartilage



THE PEDIATRIC AIRWAY

The Lungs

Creation of alveoli until
Age 8



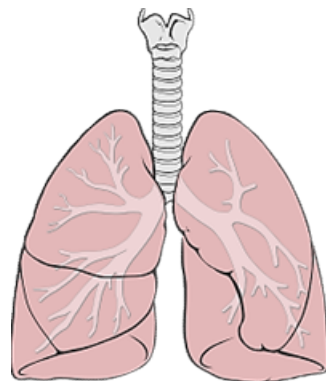
THE PEDIATRIC AIRWAY

How Babies Breathe

Functional residual capacity
Closing capacity

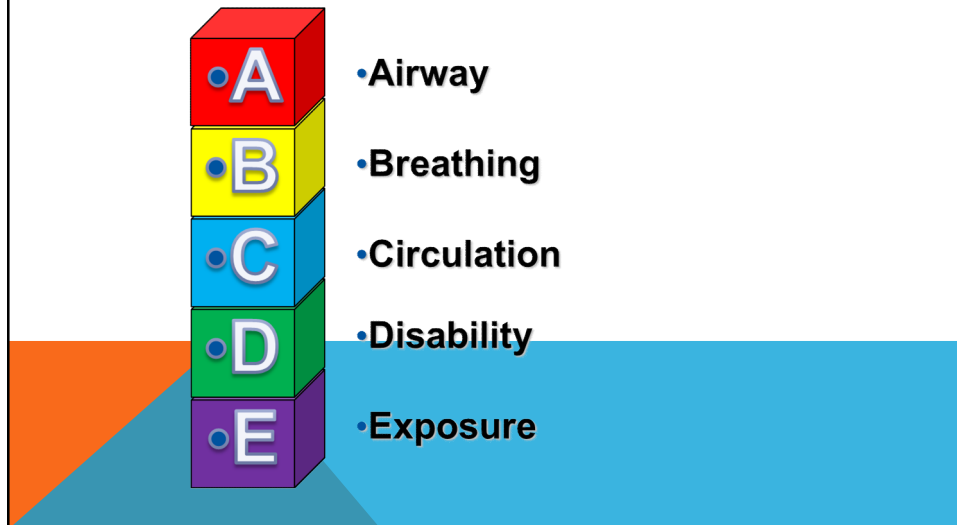
Malacia at any level

Less accessory muscle



WHY IS THIS IMPORTANT?

Respiratory support is the beginning of stabilization.



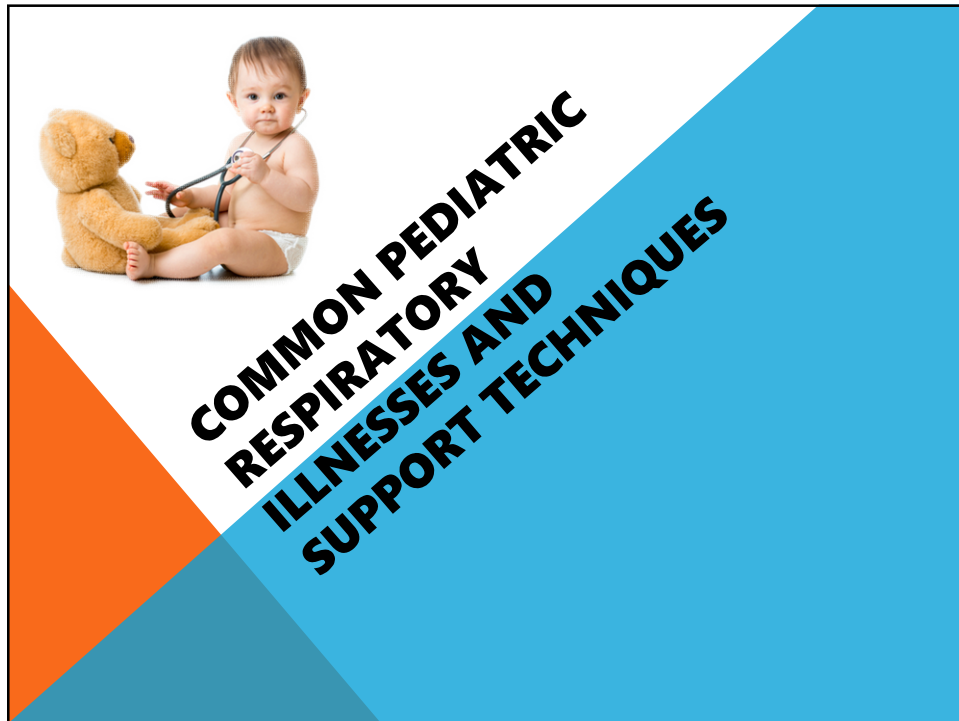
SUMMARY

Pediatric respiratory support is only a small part of EMS services.

Trauma (including thoracic trauma) is a big part of pediatric morbidity and mortality.

The pediatric respiratory system has several disadvantages.

Proper pediatric respiratory support can be lifesaving.



PEDIATRIC RESPIRATORY ILLNESSES

Vignette

12yo girl is thrown from her horse and hits a fence.

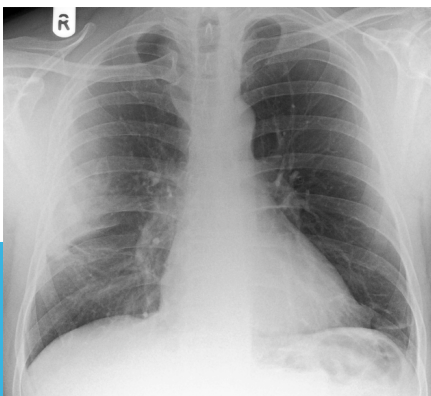
She has a large bruise on her chest; rib fractures and a pulmonary contusion are identified on CXR.



PULMONARY CONTUSION & RIB FRACTURES

Management

Usually conservative
Pulse-oximetry
Respiratory monitoring
Pain control
Respiratory support



What about flail chest?

THE SIMPLE THINGS

1. Be gentle & friendly.
2. Treat fevers.
3. Use a warm blanket.
4. Keep child with parent.
5. Examine child in parent's lap.
6. Allow a position of comfort.
7. Suction as needed
 - NeoSucker
 - Yankauer
 - Flexible suction catheter



OXYGEN THERAPY

1. Blow-by oxygen
2. Simple nasal cannula
3. Simple mask
4. Venturi mask
5. Non-rebreathers



PEDIATRIC RESPIRATORY ILLNESSES

Vignette

4-month-old ex-34-weeker

Rhinorrhea and tachypnea x4 days

Breathing fast for a day

Fever

Not drinking or eating well

Recently exposed to other sick children



BRONCHIOLITIS

Statistics

Mean duration of illness 12 days

Nearly all children experience an RSV infection within 2 years



BRONCHIOLITIS

The Sickest of the Sick

1%-3% are hospitalized, rising

- 51-90k admissions per annum
- Average duration of hospitalization 3 to 7 days
- 15% PICU
 - 1/2 mechanical ventilation, falling
 - Significant mortality



BRONCHIOLITIS

Pathophysiology

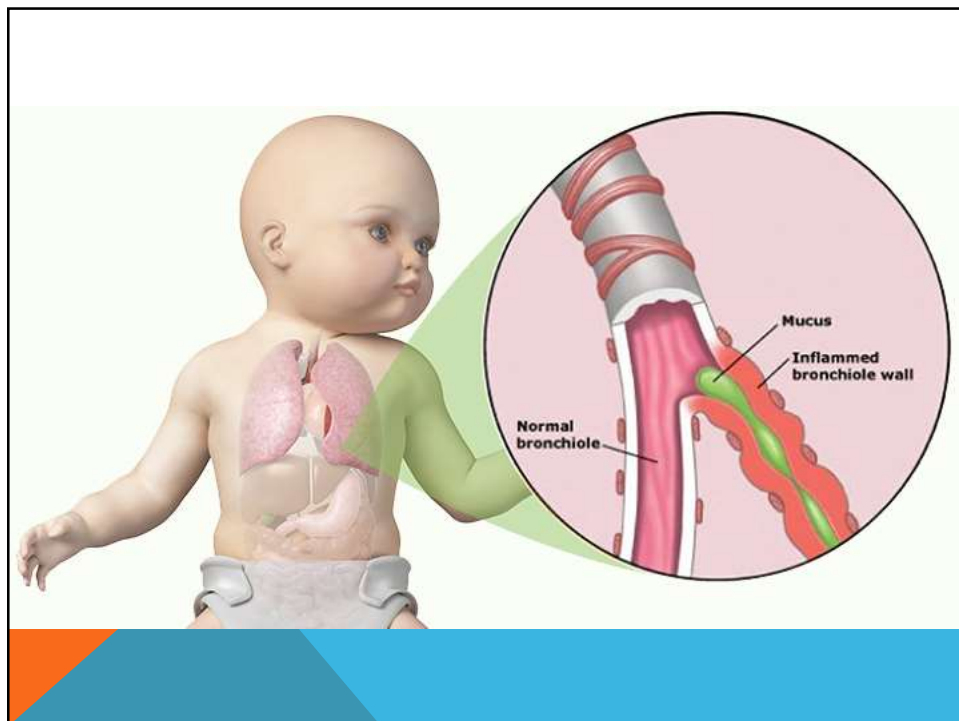
Viral infection, RSV most common (75%)

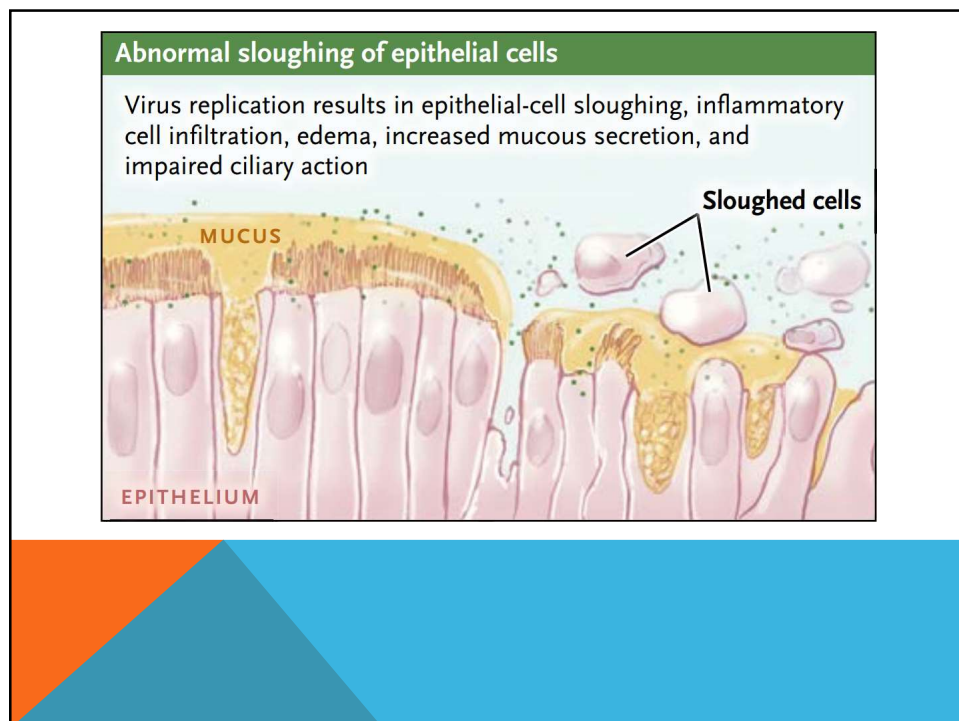
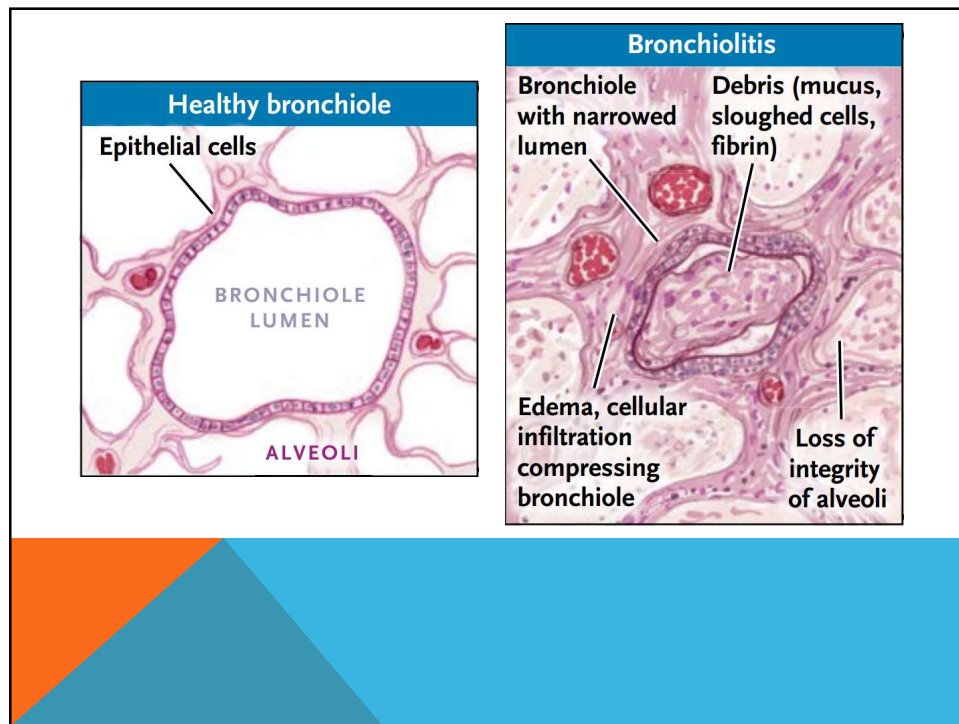
Incubation period is 2 to 5 days

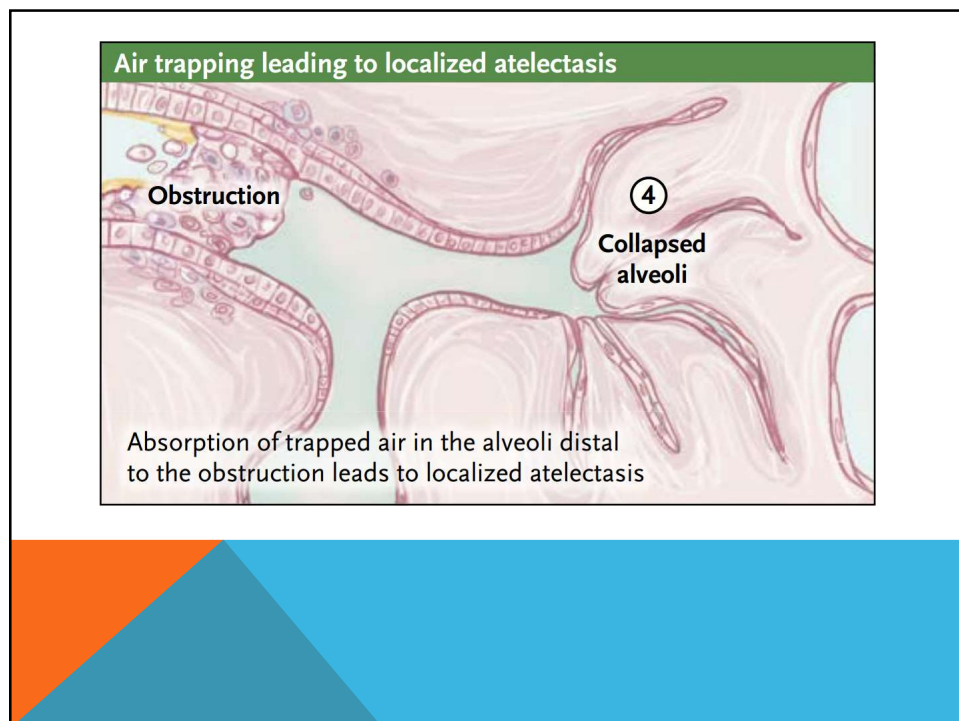
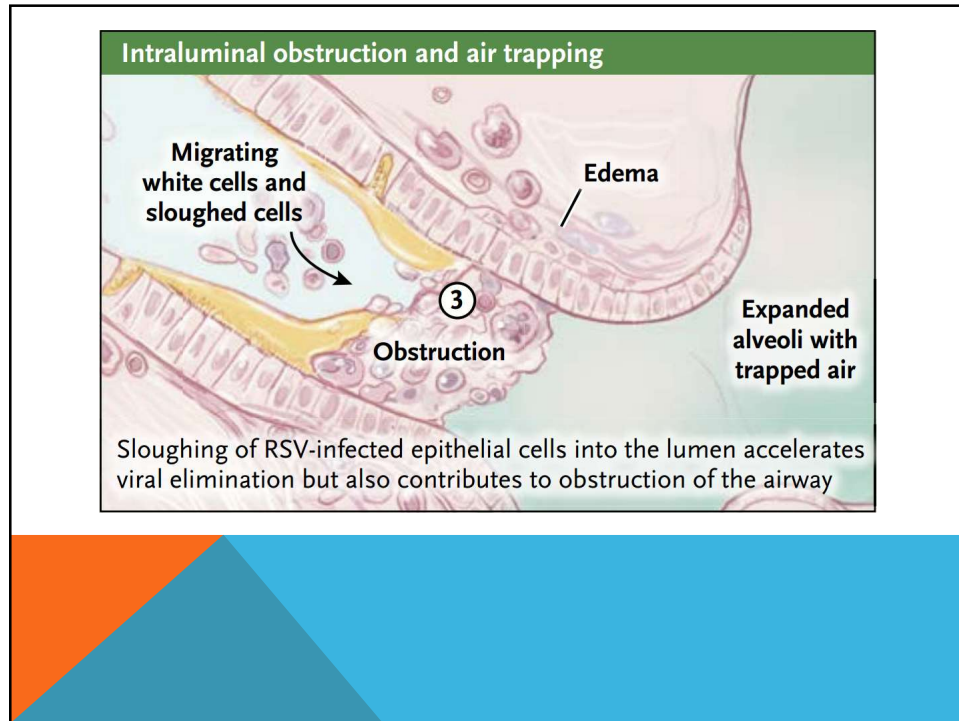
Contagious for 6 to 21 days

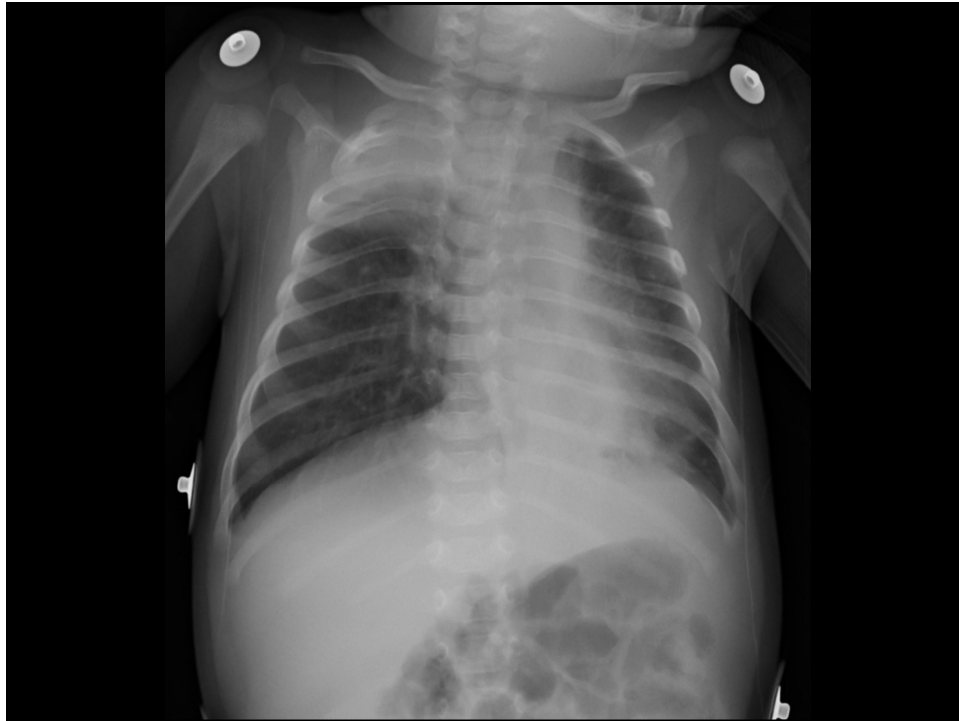
Inflammatory bronchiolar edema, air trapping

Nasal obstruction









BRONCHIOLITIS

Management

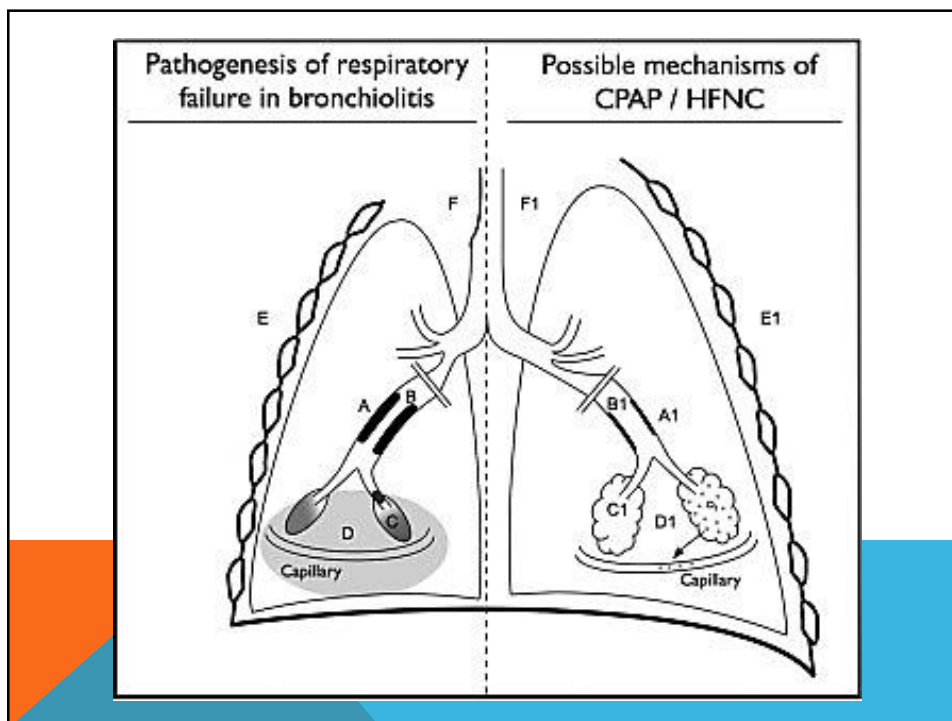
Suctioning?

Feeding tube or IV?

Respiratory treatments?

Noninvasive respiratory support?





Articles



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

Summary

Lancet 2017; 369: 930-39

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See Comment page 886

John Hunter Children's Hospital, Newcastle, NSW, Australia (E Kepreotes PhD,

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M Lee BMed, Prof J Mattes PhD);

Priority Research Centre

GrowthWell (E Kepreotes,

A Collison PhD, Prof J Mattes)

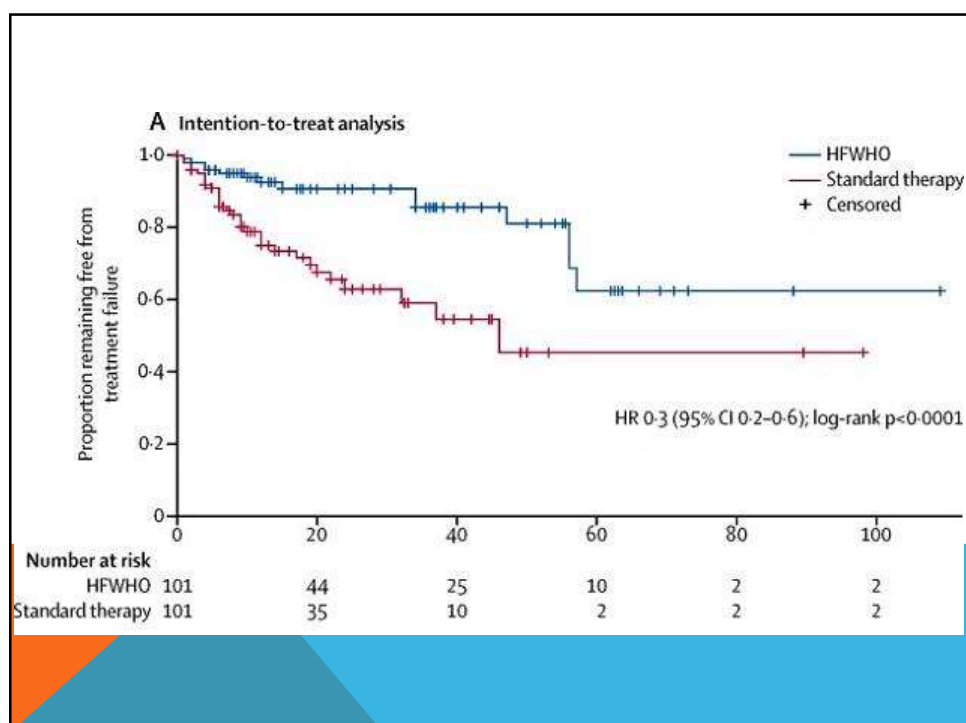
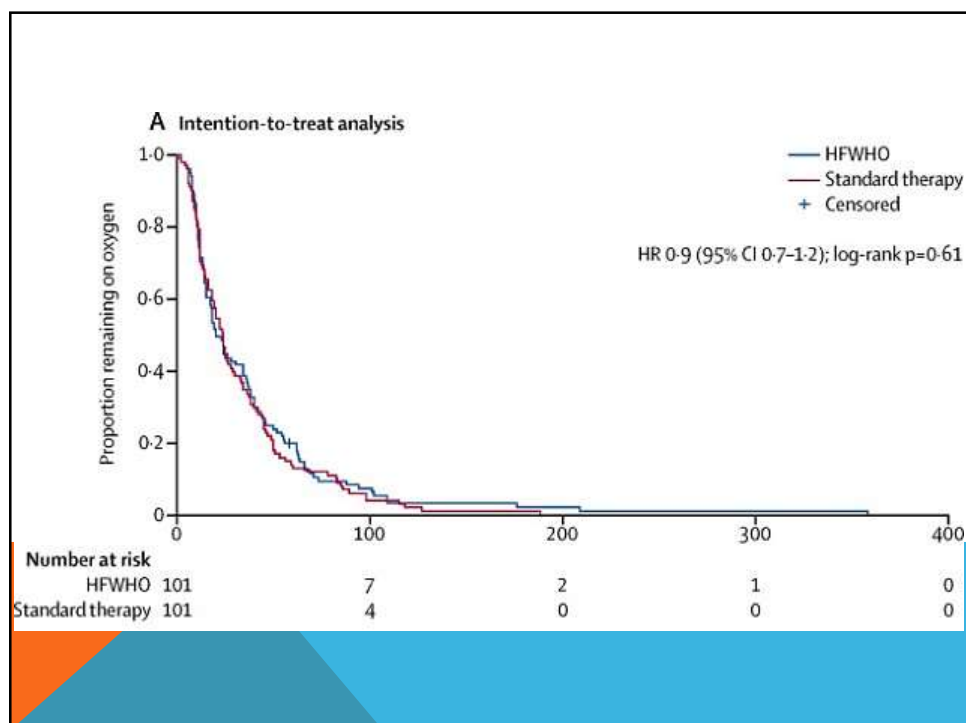
and Faculty of Health

(E Kepreotes, B Whitehead,

J Hilton, M Lee, J Mattes)

Background Bronchiolitis is the most common lung infection in infants and treatment focuses on management of respiratory distress and hypoxia. High-flow warm humidified oxygen (HFWHO) is increasingly used, but has not been rigorously studied in randomised trials. We aimed to examine whether HFWHO provided enhanced respiratory support, thereby shortening time to weaning off oxygen.

Methods In this open, phase 4, randomised controlled trial, we recruited children aged less than 24 months with moderate bronchiolitis attending the emergency department of the John Hunter Hospital or the medical unit of the John Hunter Children's Hospital in New South Wales, Australia. Patients were randomly allocated (1:1) via opaque sealed envelopes to HFWHO (maximum flow of 1 L/kg per min to a limit of 20 L/min using 1:1 air-oxygen ratio, resulting in a maximum FiO₂ of 0.6) or standard therapy (cold wall oxygen 100% via infant nasal cannulae at low flow to a maximum of 2 L/min) using a block size of four and stratifying for gestational age at birth. The primary outcome was time from randomisation to last use of oxygen therapy. All randomised children were included in the primary and secondary safety analyses. This trial is registered with the Australian New Zealand Clinical Trials Registry, number ACTRN12612000685819.



RESEARCH ARTICLE

Clinical Outcomes of Bronchiolitis After Implementation of a General Ward High Flow Nasal Cannula Guideline

Jeffrey Riese, MD,^a Timothy Porter, MD,^a Jamie Fierce, MD,^a Alison Riese, MD, MPH,^a Troy Richardson, MS, MPH, PhD,^a Brian K. Alverson, MD^a

ABSTRACT

OBJECTIVE: The goal of this study was to assess the association of the introduction of a ward's high-flow nasal cannula (HFNC) guideline with clinical outcomes of infants with bronchiolitis.

METHODS: We conducted a retrospective, pre-post intervention study with an interrupted time series analysis of infants admitted with bronchiolitis between 2010 and 2014 at an urban, tertiary care children's hospital. Patients admitted in the 24 months before and after initiation of a guideline for HFNC use on the general wards were compared. The primary outcome was length of hospital stay. Secondary outcomes were PICU transfer rate and length of stay, intubation rate, and 30-day readmission, adjusted for season.

RESULTS: A total of 1937 patients met inclusion criteria; 936 were admitted before and 1001 admitted after the introduction of HFNC use on the general wards. Comparing the 2 groups, the hospital-wide rate of HFNC use in bronchiolitis treatment increased after HFNC became available on the wards (23.9% vs 35.2%; $P < .001$). The ward's HFNC guideline was not associated with a change in preintervention trajectory of total hospital length of stay ($P = .48$), PICU length of stay ($P = .06$), or rate of PICU transfer ($P = .97$). There was also no difference in intubation rate or 30-day readmission between the 2 groups.

PEDIATRIC RESPIRATORY ILLNESSES

Vignette



3yo male noted to collapse while playing in the yard.

His face is swollen with red marks, and he has noisy, very labored breathing.

ANAPHYLAXIS

Management

Epinephrine

Albuterol, steroids, antihistamines?

Respiratory support



PEDIATRIC RESPIRATORY ILLNESSES

Vignette

14 yo male with asthma at the scene of a vehicular collision.

He does not have his albuterol and is having difficulty breathing.

ASTHMA EXACERBATION

Examination

Level of consciousness

Chest movement

Quality of breath sounds

Number of words able to be said together

1 word dyspnea

2 word dyspnea

Full sentences



ASTHMA

Risk Assessment

Prior ICU admissions

Prior intubation

>3 emergency department visits in past year

>2 hospital admissions in past year

>1 bronchodilator canister used in past month

Use of bronchodilators > every 4 hours

Chronic use of steroids

Progressive symptoms in spite of aggressive Rx

Adherence to treatment plan

ASTHMA EXACERBATION

Management

Albuterol +/- ipratropium
Steroids
Magnesium
Methylxanthines/Terbutaline
Epinephrine
Ketamine
Anesthetic gas
Respiratory support



PEDIATRIC RESPIRATORY ILLNESSES

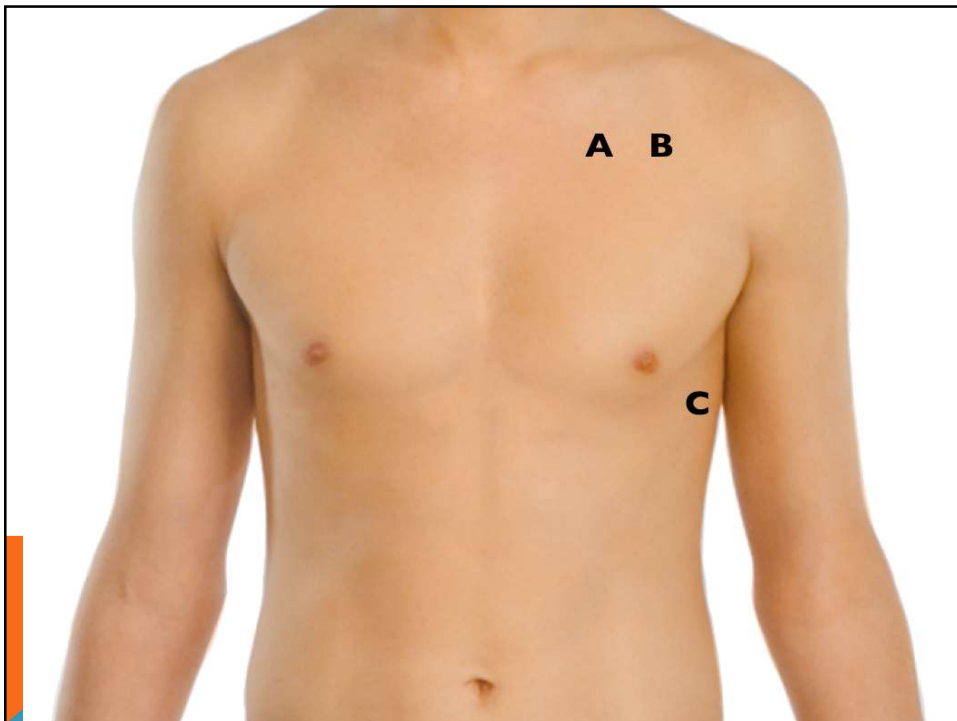
Vignette

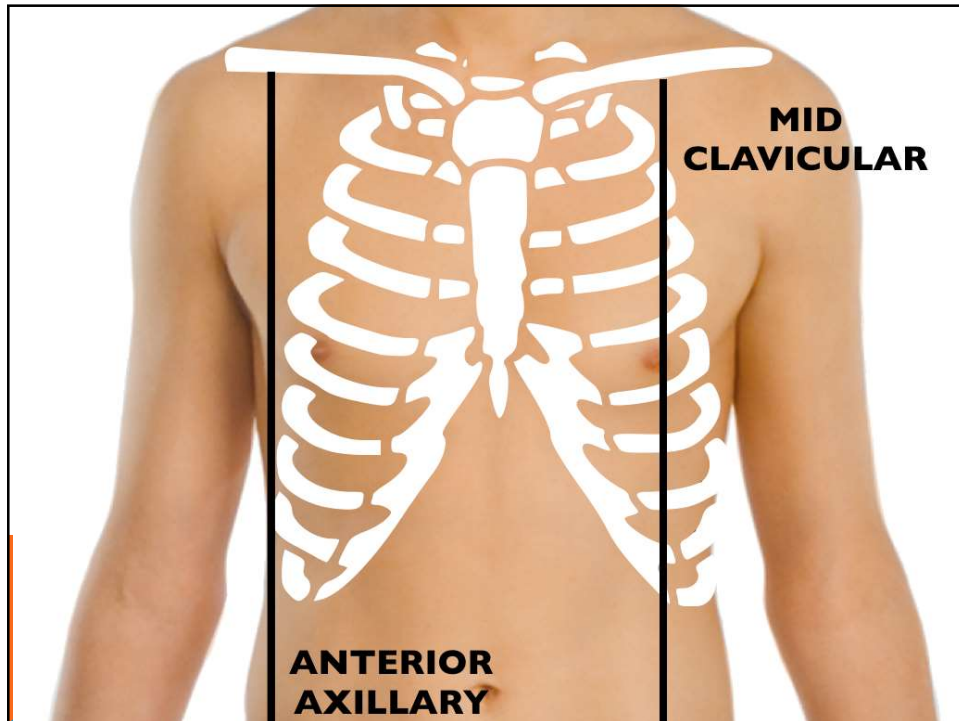
16yo male is thrown from his friend's vehicle after a highway collision.



He has rib fractures and chest pain but no obvious areas of bleeding.

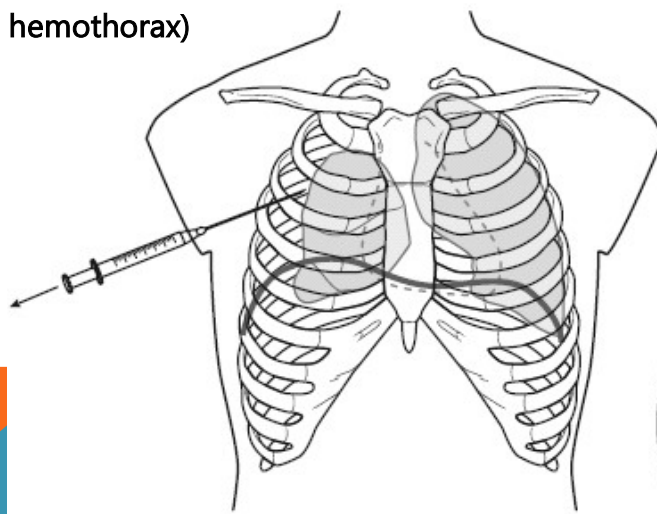
He suddenly becomes lifeless and hypotensive.





TENSION PNEUMOTHORAX

Needle Thoracentesis
(Cf. hemothorax)



PEDIATRIC RESPIRATORY ILLNESSES

Vignette

14 yo female, swimmer, honor student

3 days cough, URI, low grade fever, decreased energy

Developed difficulty inhaling today at school



VOCAL CORD DYSFUNCTION

Characteristics

High-achieving, usually female, adolescents

Frightening stridor and respiratory distress

Triggered by an emotional stressor

Management

Trial of a benzodiazepine

Referral to ENT/Speech Pathology

Psychotherapy & biofeedback

PEDIATRIC RESPIRATORY ILLNESSES

Vignette

5-month old female with URI symptoms x2 days, low grade fever, increased WOB and wheezing today.

Initial treatment=Albuterol. No change in respiratory status after treatment.

Reassessment=Biphasic monophonic wheezing.

HINT

FOREIGN BODY

Signs and Symptoms

Sudden onset of:

- Respiratory distress
- Choking
- Coughing
- Stridor
- Wheezing

Pearls

Is it SAFE?

Infants and esophageal FB's

Organic worse than inorganic



FOREIGN BODY

Management

Minimize intervention

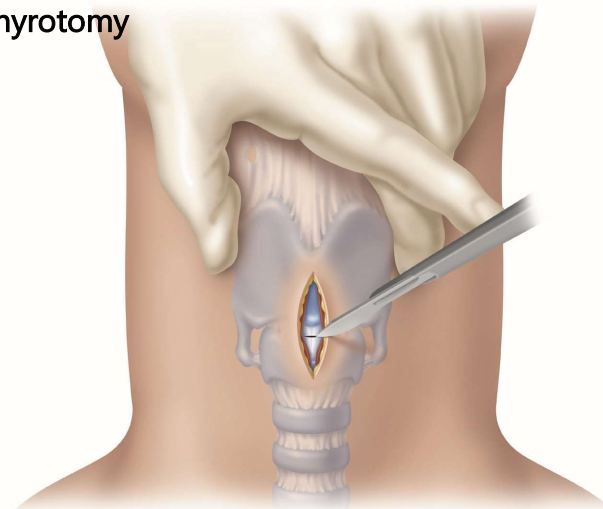
100% oxygen as tolerated
No blind sweeps of oral cavity

Inadequate ventilation

Infant: 5 back blows/5 chest thrusts
Child: Abdominal thrusts or Heimlich maneuver
Foreign Body Aspiration
Surgical Airway?

SURGICAL AIRWAY

Cricothyrotomy



FOREIGN BODY



PEDIATRIC RESPIRATORY ILLNESSES

Vignette

20-month-old male with rhinorrhea, fever, a hoarse cry and a progressively-worsening, harsh, "barky," cough

Today he developed "wheezing."



CROUP

Pathophysiology

Usually parainfluenza type 1

Affects the larynx and trachea, causing subglottic edema

Demographics

6 months to 4 years

Males > females

Fall and early winter



CROUP

Signs and Symptoms

"Cold" progressing to hoarseness, cough

Low grade fever

Night-time increase in edema with:

Stridor – high pitched INSPIRATORY sound

"Seal bark" cough

Respiratory distress

Recurr on several nights



CROUP



CROUP

Management

Mild Disease

Reassurance
Moist, cool air

Severe Disease

Racemic epinephrine
Dexamethasone
Respiratory support



PEDIATRIC RESPIRATORY ILLNESSES

Vignette

A 2-year-old Amish boy has stridor, high fever, and severe respiratory distress.

He is toxic-appearing, leaning forward on his arms and drooling.



EPIGLOTTITIS

Pathophysiology

- Bacterial infection
- Rarely seen since Hib vaccine
- Affects epiglottis, adjacent pharyngeal tissue
- Supraglottic edema
- Complete Airway Obstruction



EPIGLOTTITIS

Incidence

Ages 4-7 (slightly older than croup)

More common in unimmunized children

Much less common than previous

Signs and Symptoms

Rapid onset with fulminant progression

High fever with toxic appearance

Drooling

Stridor

Tripodding

EPIGLOTTITIS

Management

Position of comfort

Dark, quiet room

Urgent anesthesia and surgical/ENT consultation

Do not examine the oropharynx!

Do not place an IV!

Antibiotics later



RESPIRATORY ILLNESSES

Rib fractures and pulmonary contusion

Bronchiolitis

Anaphylaxis

Asthma

Tension pneumothorax

Vocal cord dysfunction

Foreign body

Croup

Epiglottitis

MATCH THE MEDICATION WITH THE CONDITION

Respiratory Medications

1. Albuterol nebulization
2. Epinephrine 1:1000
3. Epinephrine 1:10000
4. Epinephrine – Racemic
5. Ipratropium/Atrovent
6. Magnesium Sulfate
7. Methylprednisolone/Solu-Medrol
8. Dexamethasone/Decadron
9. Midazolam/Versed
10. Morphine

- Rib fractures and pulmonary contusion
- Bronchiolitis
- Anaphylaxis
- Asthma
- Tension pneumothorax
- Vocal cord dysfunction
- Foreign body
- Croup
- Epiglottitis

THE GAMBIT OF SUPPORT

1. Be gentle; decrease oxygen consumption.
2. Allow a position of comfort.
3. Suction.
4. Simple nasal cannula
5. Simple mask, Venturi mask, and non-rebreathers
6. High-flow nasal cannula
7. Surgical procedures

