

Respiratory tract emergency

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Outline

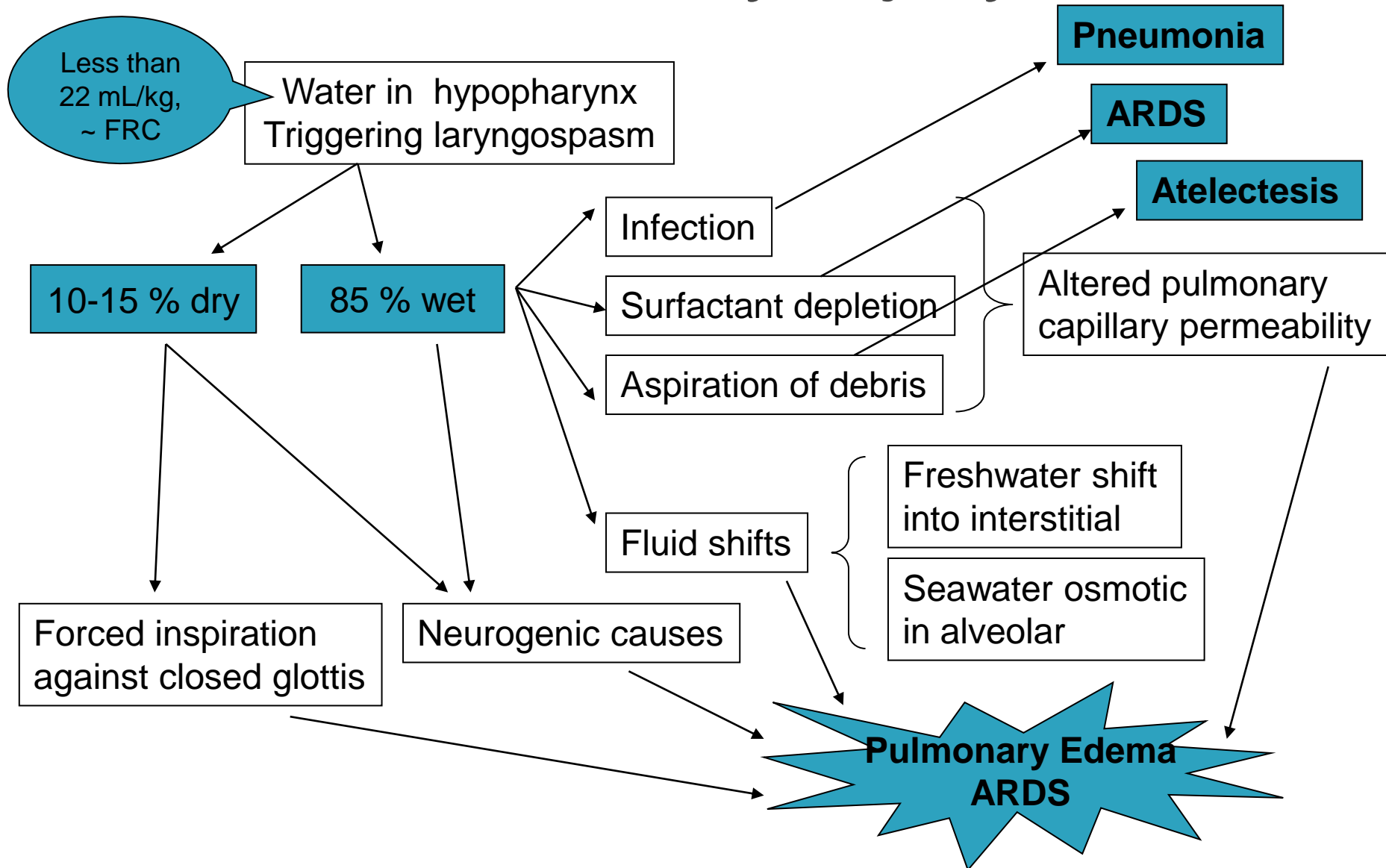
- Drowning
- Foreign body aspiration
- Air leak syndrome
- Septic shock
- Respiratory failure and ARDS
- RS in ER setting: COVID-19 era

Drowning

- A process resulting in primary respiratory impairment from submersion/immersion in a liquid medium both fatal and nonfatal outcomes
- Highest mortality in children 0-4 yr and 15-19 yr
- Second leading cause of death from unintentional injury (First motor vehicle injury)
- Precipitating events : syncope, seizure, arrhythmia, drugs, alcohol, hypothermia, trauma, child abuse, suicide

- Pulmonary injury → Nonpulmonary sequale
 - Hypothermia – $<35^{\circ}\text{C}$ impaired muscle coordination
 - Electrolyte imbalance – rare
 - Trauma – C spine injury 0.5%, internal organs
 - Hypoxic-ischemic damage
 - Most – brain, Least – GI
 - Myocardial dysfunction → hypotension, arrhythmia
 - Vascular endothelium injury → DIC
- Nonspecific pathologic findings : emphysema
acquosum

Pulmonary Injury



1. Cardiopulmonary Resuscitation with C spine protection
2. Respiratory support
 - Broad-spectrum antimicrobials
 - Diuretic for pulmonary edema
 - Rewarming, cardiopulmonary bypass if BT < 26-28 °C or cardiac arrest
3. Hemodynamic support
4. Neurologic support
 - Cooling to core temperature 32° to 34° C for 24 to 48 hr
 - Treatment for increased ICP
5. Temperature and Metabolic support

- Outcome
 - 50% progressing to pulmonary edema, usually during the 1st 4-8 hr after event
 - Bronchial hyperreactivity, peripheral airways disease, chronic lung disease
 - Prediction of neurologic outcome
 - Severity of illness scores

- Prevention
 - Education campaigns : water safety education, danger of intoxication while in and around water
 - Adult supervision of infant and young children
 - Barrier : pool fencing, self-closing, latching gate (reduce incidence of drowning 50-80 %)
 - Lesson : swimming-5 yr
 - Effective strategy in younger, not older children
 - Not “Drown proof”

Foreign body aspiration

- Most victims : older infants and toddlers
- Liquid (most common), small object, food
- Most airway FB lodge in main bronchus
- DDx esophageal FB compressing trachea
- Chronic complications : obstructive emphysema, atelectasis, pneumonia, lung abscess, bronchial stricture, bronchiectasis, TE fistula, bronchopleural fistula

- Diagnosis
 - Clinical = initial → asymptomatic → complications
 - Choking or coughing episodes
 - Stridor or wheezing, depend on the location and degree of luminal obstruction
 - Complete obstruction of the airway : sudden cyanosis, respiratory distress, **voiceless speaking or coughing**
 - Imaging : Plain films (normal 10-30%), CT scan (detect non-opaque object)
 - Rigid bronchoscopy



Inspiratory film



Expiratory film

- CXR AP and Lateral
 - Include entire neck
- CXR AP insp and exp
 - Air trapping
- CXR Lt/Rt Lat decubitus
 - Infants and younger children
 - The side with FB → not deflate in the dependent position

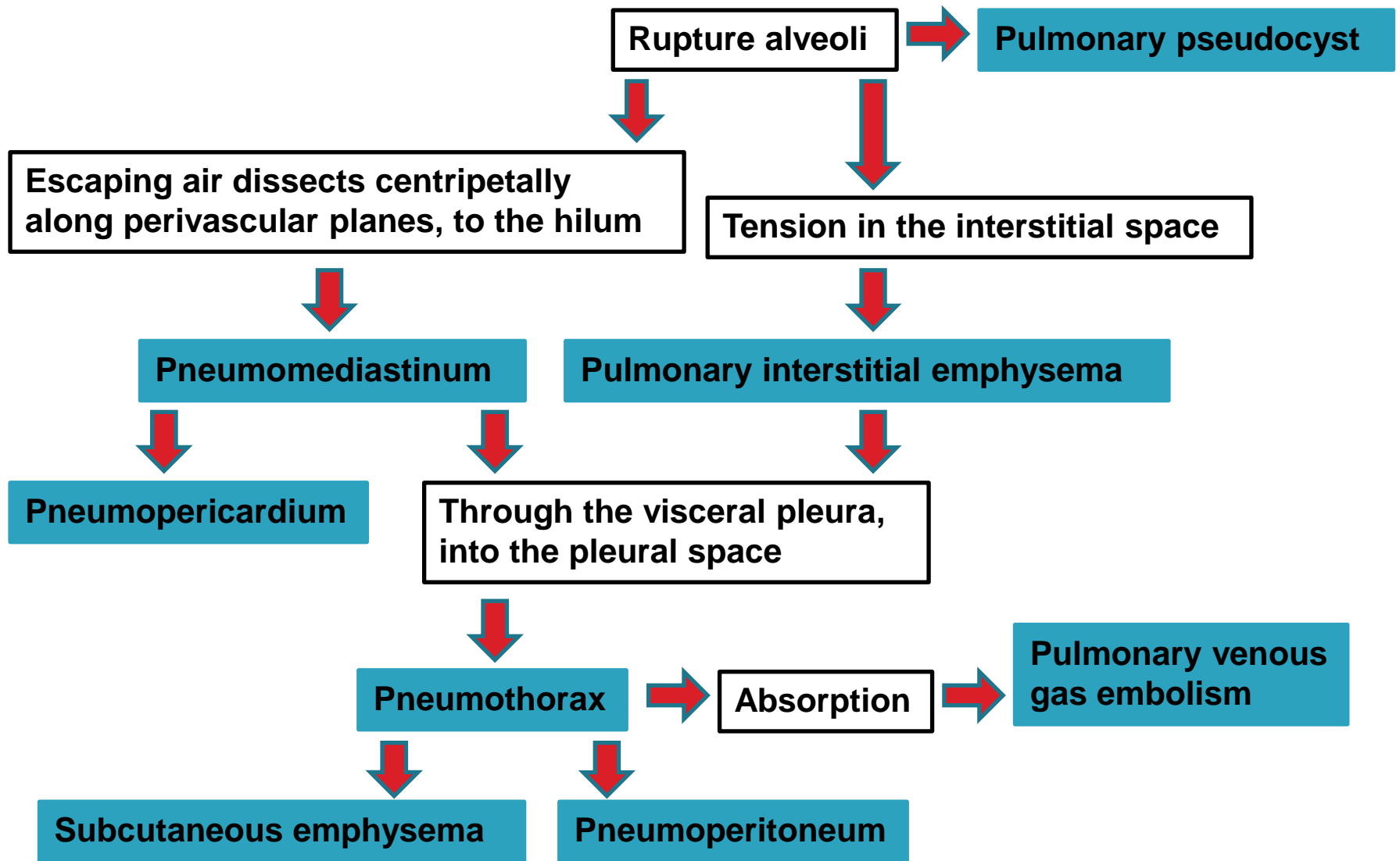
- Partial airway obstruction
 - Do not interfere
 - Urgency bronchoscopy
- Complete airway obstruction : immediate action
 - Remove foreign body maneuver
 - Rigid bronchoscopic removal
 - Thoracotomy, if failed bronchoscopy

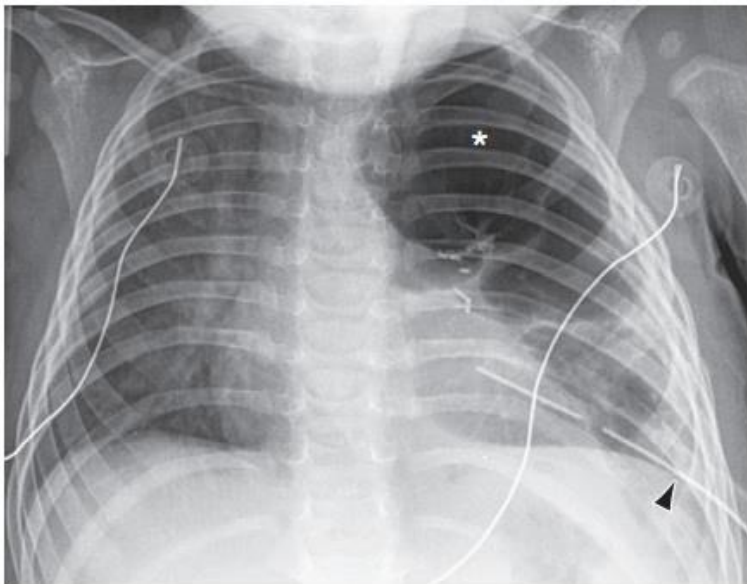
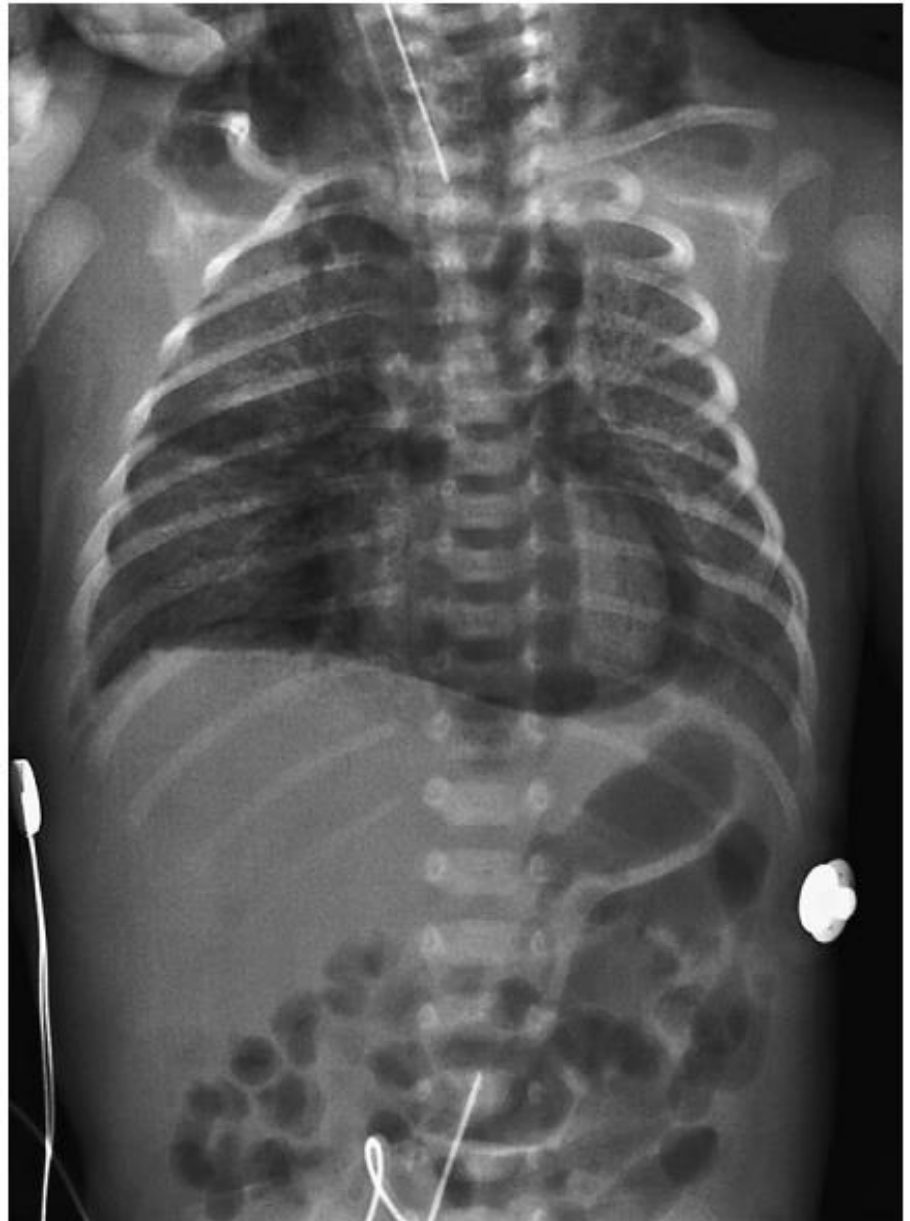
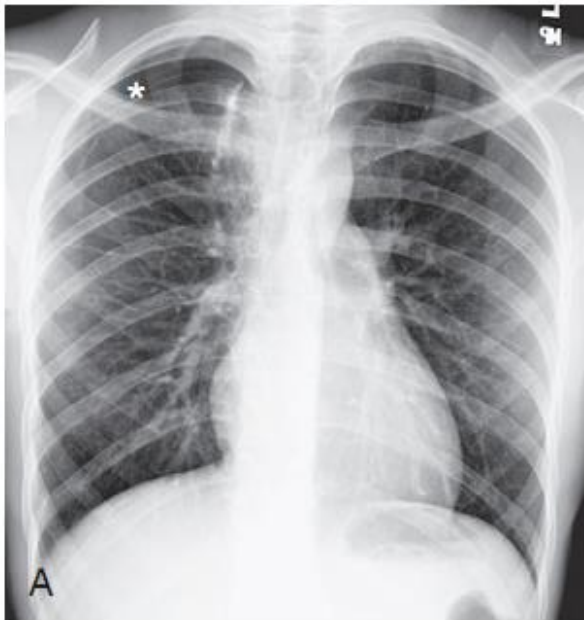


- Open the airway, remove foreign body, **but not blind finger sweeps**
- If no response
 - Infant <1yr : **5 back blows & 5 chest thrusts**
 - Child : **5 Heimlich maneuver**
- After each cycle, open the mouth for removing foreign body
- If cardiac arrest, start chest compression
- Not giving rescue breathing
- On ETT one lung ventilation

Air leak syndrome

- Etiologies of air leak syndrome
 - Chest wall defect through parietal pleura
 - Laceration of major airways
 - Alveolar rupture
 - Rarely from infection with gas-producing microorganisms





- Primary spontaneous pneumothorax
 - Teenager, males, tall, thin (e.g.) → subpleural bleb
 - Mutations in the folliculin gene
 - Collagen synthesis defect : Marfan's syndrome, Ehlers-Danlos disease
 - Cigarette smoking
- Secondary spontaneous pneumothorax
 - Underlying disorder without trauma : Infection, asthma, foreign body, ecstasy abuse, etc
- Trauma, iatrogenic
- Catamenial pneumothorax

Etiologies

First breath
Diagnostic and therapeutic maneuvers
Thoracentesis
Aspiration lung biopsy
Percutaneous pleural biopsy
Cardiothoracic surgery
Resuscitation
Ventilator therapy, especially with positive end-expiratory pressure
Lower respiratory tract diseases
Hyaline membrane disease
Aspiration syndrome
Asthma
Cystic fibrosis
Tuberculosis (cavitary, miliary)
Pneumonia and bronchiolitis
Malignancy (primary or metastatic)
Blunt thoracic trauma

Connective tissue disease
Interstitial lung disease
Pulmonary infarction

- Vary symptoms according to lung collapse, rapidity of onset, respiratory reserve
 - Asymptomatic to abrupt dyspnea, pain, cyanosis
 - Bulging chest wall, subcutaneous emphysema
 - Tympanic percussion, decreased breath sounds over the involved side
 - Pneumomediastinum
- Severe in tension pneumothorax, intrapleural pressure > atmosphere
 - Shift of mediastinum toward unaffected side

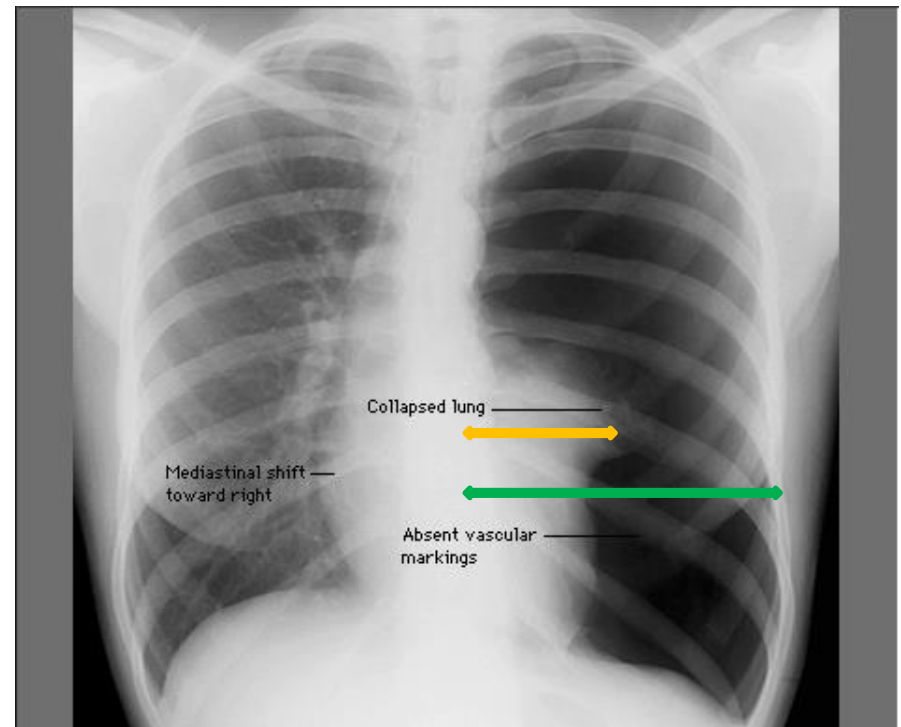
- CXR Upright inspiratory

$$\text{Size of pneumothorax (\%)} = (1 - [L^3/H^3]) \times 100$$

L = diameter of the collapse lung

H = diameter of the hemithorax

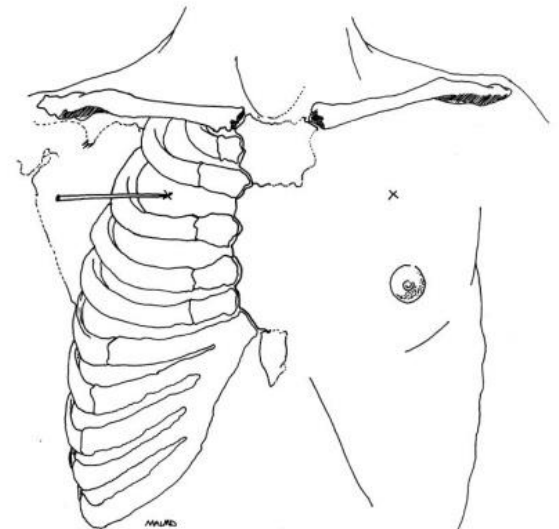
- CT : detect bullae & bleb in recurrent pneumothorax or inconclusive radiograph



- Treatment

- If no continuous air leak, small size < 5-15% : spontaneous resolution within 7-12 days
 - Room air, clear of 1.25% of the hemithorax daily
 - Breathing 100% oxygen hasten absorption 6-7 folds (PaN₂ near zero → less venous gas pressure than atmosphere)
- Close clinical and/or blood gas monitoring
- Analgesic for pleuritic pain

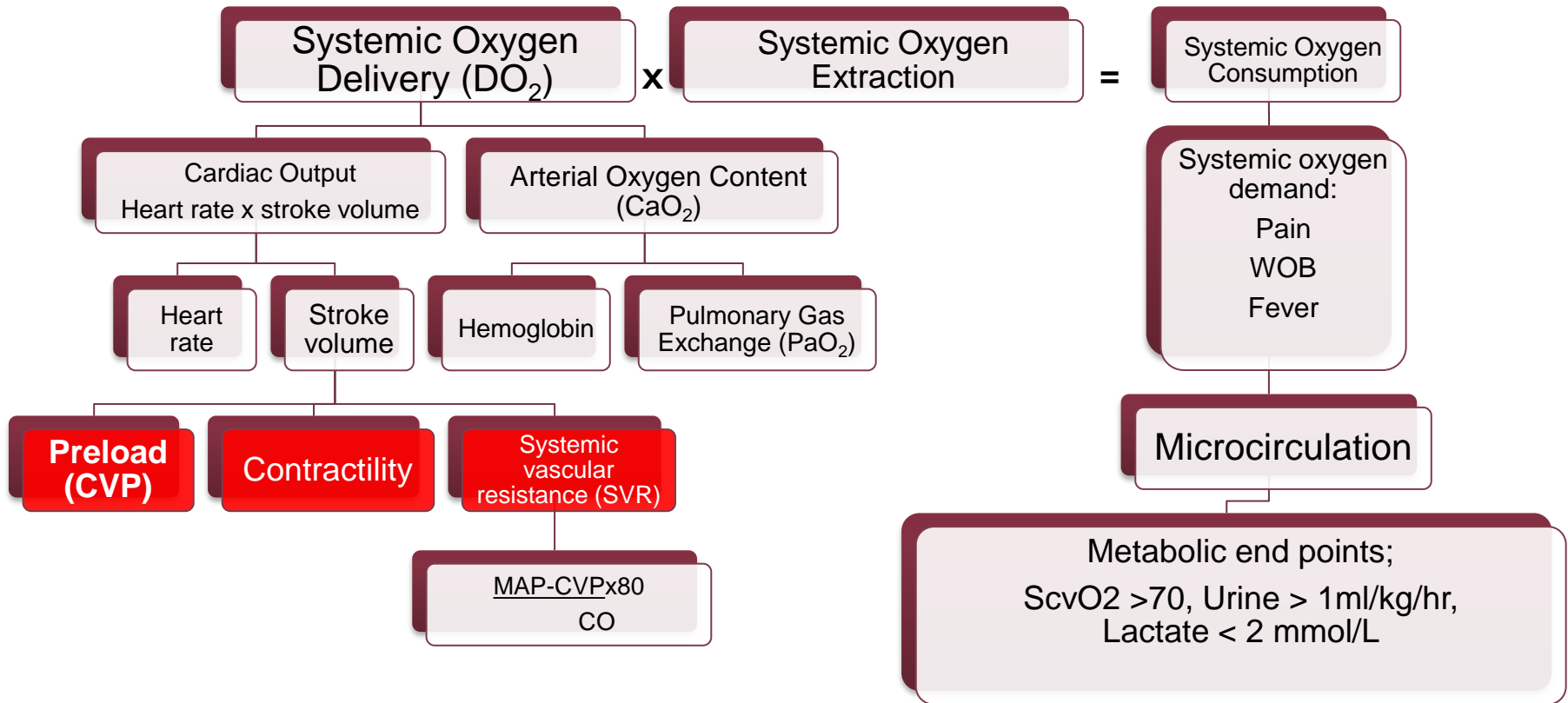
- For tension pneumothorax → needle thoracotomy as effective as tube thoracostomy in ER



- Definitive treatment for recurrent pneumothorax or 1st episode in cystic fibrosis
 - VATs for bleb plication, fistula closure, pleural stripping, basilar pleural abrasion, or sclerosing agents
 - Chemical pleurodesis → pleural adhesion : talc, doxycycline, tetracycline, autologous blood, fibrin glue, or iodopovidone
- Chest physiotherapy with caution, avoid PEP
- Recurrence 40 – 87%, avoid air travel, contact sports, playing wind musical instruments 4 wks

Septic shock

Microcirculation



**0 min
ER**

- Recognize decreased mental status and perfusion.
- Begin high flow O₂ .Establish IV/IO access.

5 min

- Initial resuscitation : push boluses of 20 cc/kg isotonic saline or colloid up to & over 60 cc/kg until perfusion improves or unless rales or hepatomegaly develop.
- Correct hypoglycemia & hypocalcemia.
- begin antibiotics.

15 min

**Shock not
reversed ?**

Initial Resuscitation

- Oxygen therapy
 - Face mask oxygen
 - High flow nasal cannula oxygen or nasopharyngeal CPAP for respiratory distress
- Vascular access
 - Peripheral i.v. access or intraosseous access (if fail time more than 90 sec) can be used for fluid resuscitation and inotrope infusion when a central line is not available.

**0 min
ER**

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**Shock not
reversed ?**

Antibiotics

- Empiric antimicrobials must be administered within 1 hr of the identification of severe sepsis.
 - Blood cultures obtained before administering antibiotics when possible, but this should not delay initiation of antibiotics.
 - The empiric drug choice should be changed as epidemic and endemic ecologies dictate (eg, H1N1, MRSA, chloroquine-resistant malaria, penicillin-resistant pneumococci, recent ICU stay, neutropenia)
- Suggest the use of clindamycin and antitoxin therapies for toxic shock syndromes with refractory hypotension
- Recommend early and aggressive infection source control

Target Goals (within 6 hours)

- Capillary refill ≤ 2 sec
- Normal blood pressure
- Strong pulse and no difference between peripheral pulse and central pulse
- Urine output > 1 mL/kg/hr
- Central venous saturation (ScvO_2) $> 70\%$
- Cardiac index 3.3-6.0 L/min/m²
- Normal lactate level (< 4 mmol/L or decreased ≥ 10 %/hr until normal)
- Normal mental status

Fluid refractory shock :

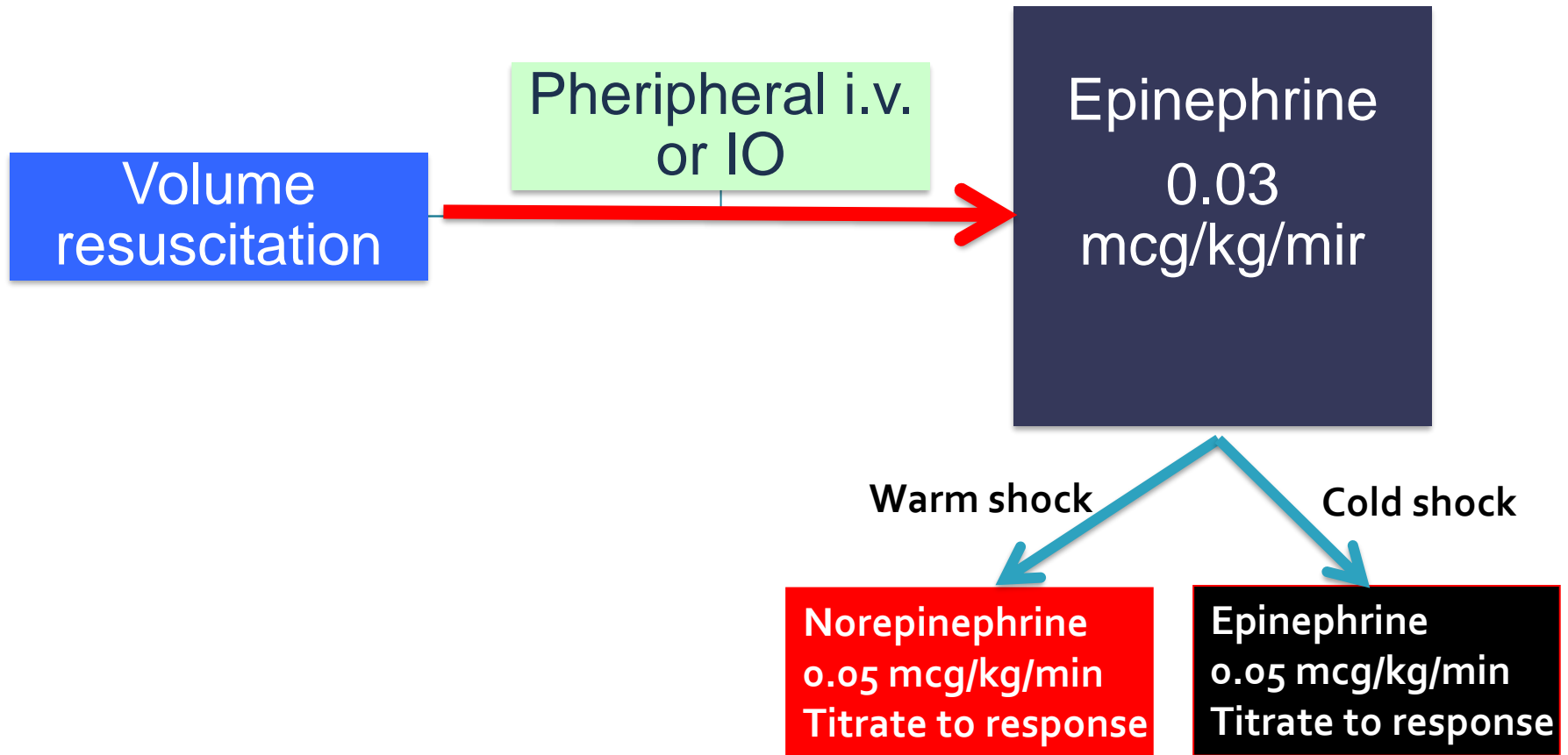
- begin inotrope IV/IO,
- Use atropine/ketamine IV/IO/IM to obtain central access & airway if needed.
- Reverse cold shock by titrating central dopamine Or if resistant ,titrate central epinephrine
- Reverse warm shock by titrating central norepinephrine

15min

Dose range:
Dopamine up to
10 mcg/kg/min,
Epinephrine
0.05 to 0.3
Mcg/kg/min

**Shock not
reversed ?**

Vasoactive Infusions



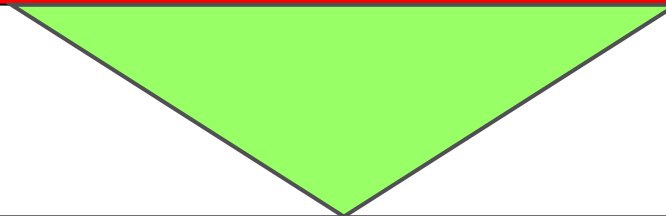
60min

**Catecholamine resistant shock :
begin hydrocortisone
If at risk for absolute adrenal insufficiency**

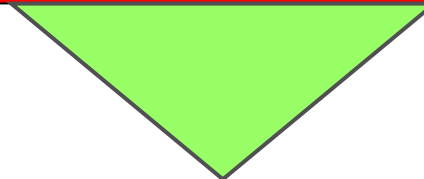
Monitor CVP in PICU,attain normal MAP-CVP & ScvO₂>70%



**Catecholamine resistant shock :
begin hydrocortisone
If at risk for absolute adrenal insufficiency**



Monitor CVP in PICU, attain normal MAP-CVP(PP) & ScvO₂>70%



Resuscitation end points

Macro circulation

CVP 8–12 mm Hg
(MAP) ≥ 65 mm Hg
Urine output \geq 0.5 mL/kg/hr
SCVO₂(superior vena cava) $\geq 70\%$ or SVO₂ $\geq 65\%$,

Micro circulation

Lactate < 2 mmol/L
SCVO₂ $> 70\%$

Tissue hypoperfusion can persist despite normal vital sign.

Biomarkers

Achieved all tasks within 6 hours

Cold shock with normal blood pressure :

1. Titrate **fluid & epinephrine**, ScvO₂ >70%, **Hb >10g/dl**
2. If ScvO₂ still <70%, Add vasodilator with **volume Loading** (nitrovasodilators, **milrinone**, **imrinone**, & others) Consider levosimendan

Cold shock with Low blood pressure :

1. Titrate **fluid & epinephrine**, ScvO₂ >70%, **Hb >10g/dl**
2. If still hypotensive Consider **norepinephrine**
3. If ScvO₂ still <70% consider **Dobutamine**, **milrinone**, **Enoximone** or **levosimendan**

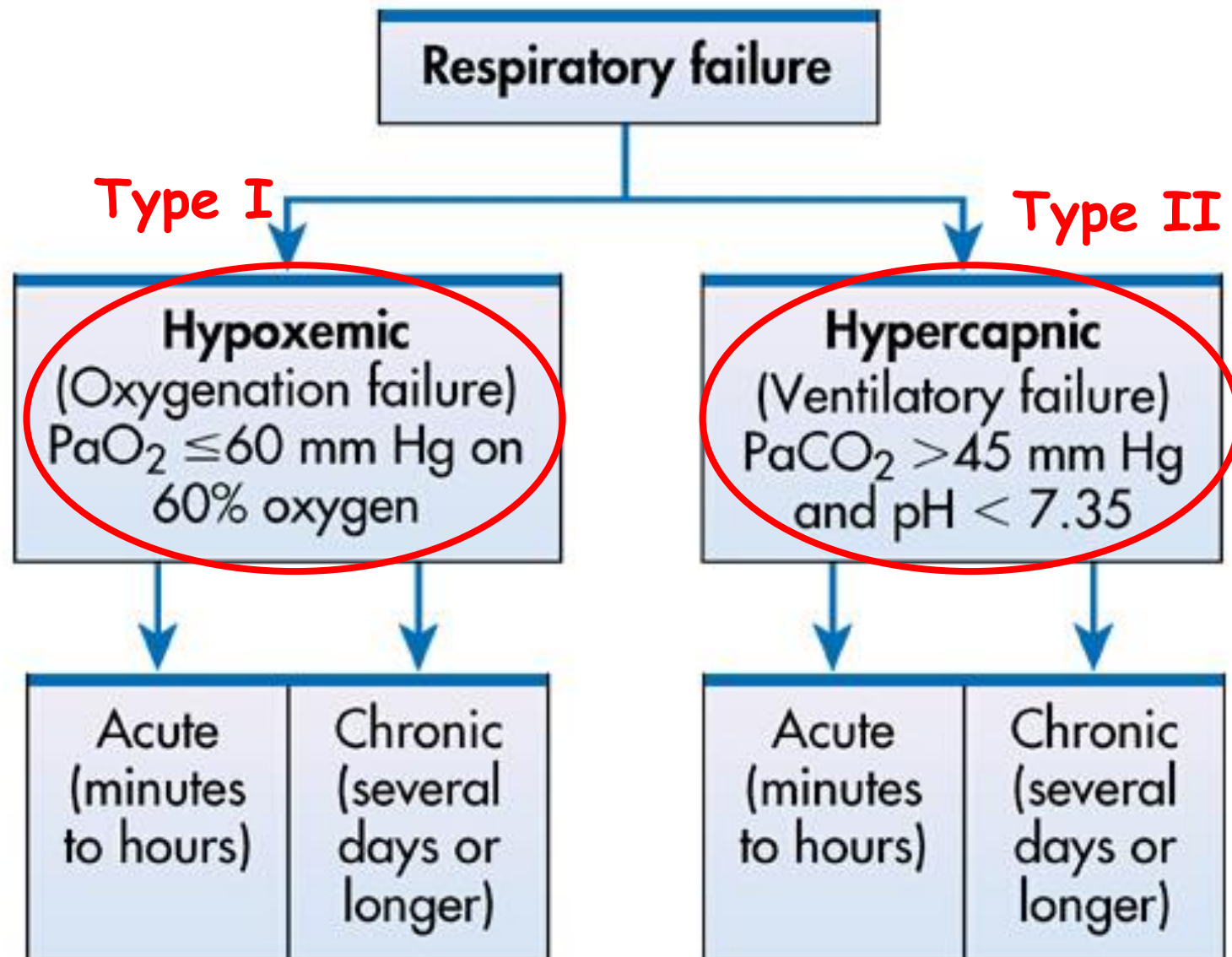
Warm shock with

Low blood pressure :

1. Titrate **fluid & norepinephrine**, ScvO₂ >70%,
2. If still hypotensive Consider vasopressin, Terlipressin or angiotensin
3. If ScvO₂ still <70% Consider low dose epinephrine

Shock not reversed?

Respiratory failure



Criteria for Diagnosis

Clinical criteria

- ↓ or absent respiratory breath sound
- Severe inspiratory retraction
- Cyanosis in 40% O₂
- ↓ Level of consciousness
- Poor skeletal muscle tone

Physiologic criteria

- PaCO₂ > 50 mm Hg
- PaO₂ < 100 mm Hg in 50% O₂

Acute respiratory failure = 3 Clinical + 1 Physiologic

Acute respiratory failure

Clinical manifestations

Hypoxemia - tachycardia, tachypnea, sweating, restlessness, hypotension

CO₂ retention - headache, confusion, coma

Abnormal respiratory signs - stridor, adventitious sounds

Acute respiratory failure

Ventilatory failure: CO_2 retention

- Disease of brain & spinal cord
- Disease of peripheral nerve, muscle
- Drug overdose
- etc

Acute respiratory failure

Oxygenation failure: hypoxemia, low PaO_2

- Upper airway obstruction
croup, laryngeal edema, etc
- Small airway diseases
acute bronchiolitis, asthma, etc
- Parenchymal diseases
ARDS - pneumonia, near-drowning, etc

Respiratory management

Management

- Treat primary insult
- Adequate tissue oxygenation
 - Oxygenation
 - NIV
 - Mechanical ventilation
- Prevent complications

Mechanical ventilation

- Low tidal volume
- Precaution if high FiO_2 for more than 24 hour
- Lung recruitment strategy in ARDS
- High PEEP in ARDS
- Considered HFOV

ARDS

Berlin's definitions

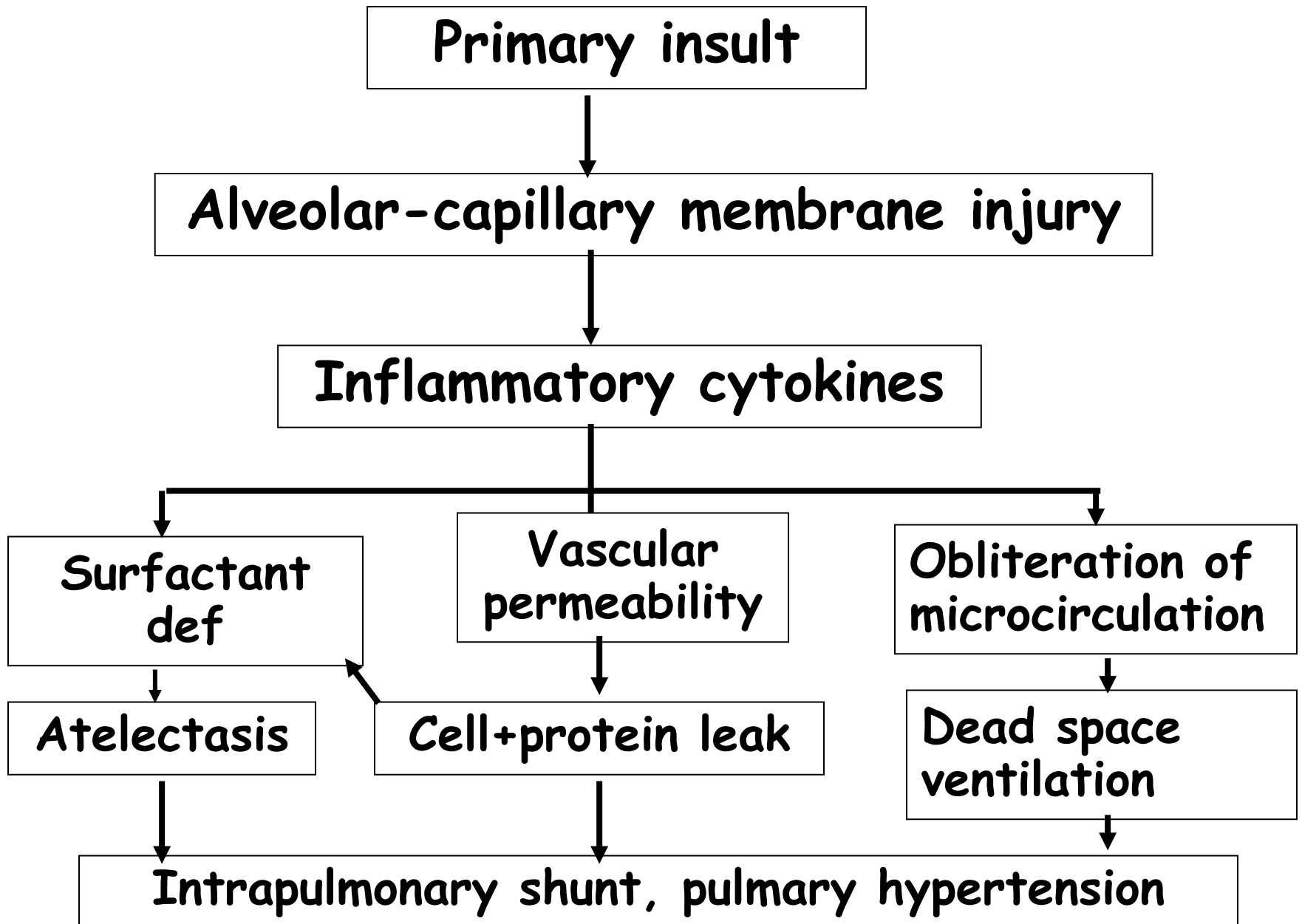
- Acute onset within 7 days
- Bilateral opacities
- PF ratio less than 300
 - <300 = mild
 - <200 = moderate
 - <100 = severe
- Exclude volume overload

Pathophysiology

Primary insult to lungs

- Direct injury : aspiration เช่น near-drowning, gastric, hydrocarbon, etc
- Indirect injury : sepsis, brain edema, etc

Alveolar-capillary membrane injury



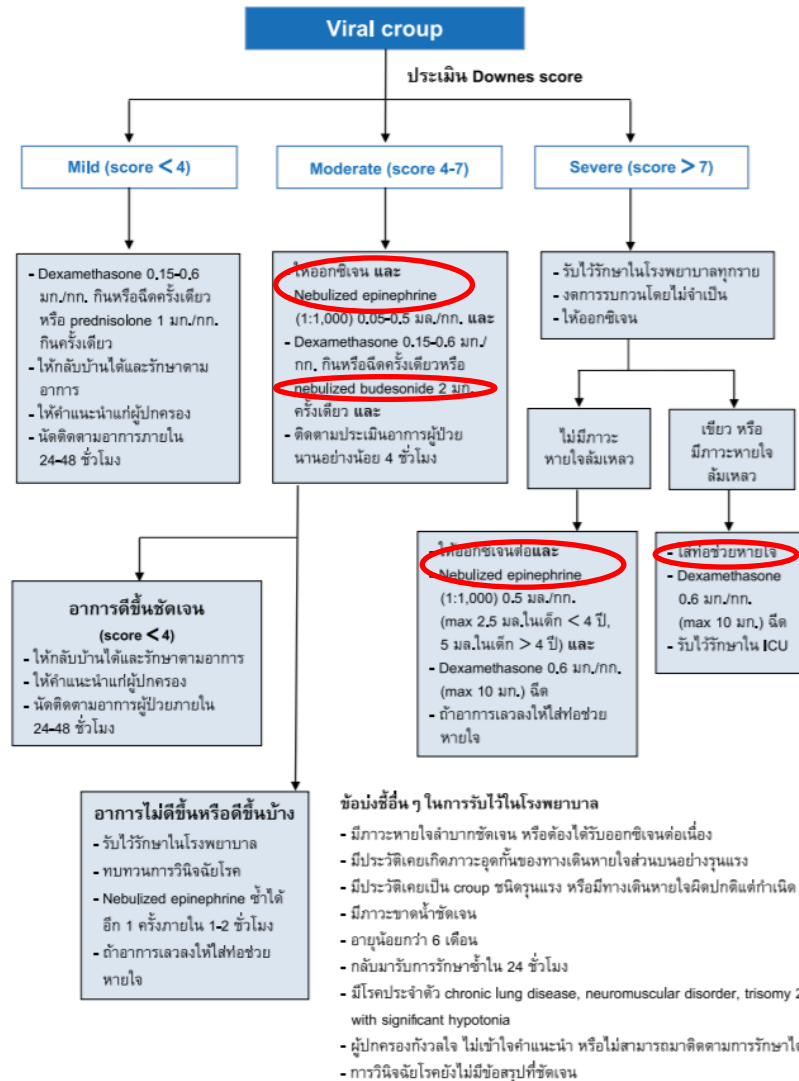
Management

- Treat primary insult
- Adequate tissue oxygenation
 - Oxygenation
 - NIV
 - Mechanical ventilation: **high PEEP** with recruitment protocol
- Prevent complications



RS in ER setting: COVID

- ส่วนใหญ่มักจะมี **Respiratory distress**
- ใช้ ไอ หอบ มาที่ ER
 - ☐ Croup
 - ☐ Acute bronchiolitis
 - ☐ Pneumonia
- การตรวจหาเชื้อ **respiratory virus** ต่างๆ รวมทั้ง **COVID-19**
- การดูแลผู้ป่วยใน ER



In COVID Era

- Nebulized epinephrine?
- Nebulized Budesonide?
- Oxygenation
- Intubation

- For mild croup in older children and who are not distressed, consider avoiding corticosteroids.
- For moderate to severe croup, administer oral corticosteroids (dexamethasone 0.6 mg/kg, to a maximum of 16 mg/dose).
- For severe croup, nebulized epinephrine can be used, provided that full PPE are available and all airborne precautions can be taken.
- Alternatives include an MDI for epinephrine and subcutaneous or intramuscular epinephrine.
- In settings where all airborne precautions cannot be taken, delivering epinephrine subcutaneously or intramuscularly may be considered, with dosing based on weight, as follows:
 - 7.5 to 15 kg: 0.1 mg IM/SC
 - 15 to 30 kg: 0.15 mg IM/SC
 - >30 kg: 0.3 mg IM/SC

Croup : Avoid Unnecessary Nebuliser Use

Mild Croup



Without significant stridor or
work of breathing

Severe Croup



Nebulised
Adrenaline
+
oral steroids



Airbone PPE for staff
+ Neg pressure room if possible

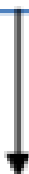


Advice is evolving. 15.3.2020
Created by STORK for CHQ



Queensland Pediatric Consensus statement: April 2020

Mild (score < 4)

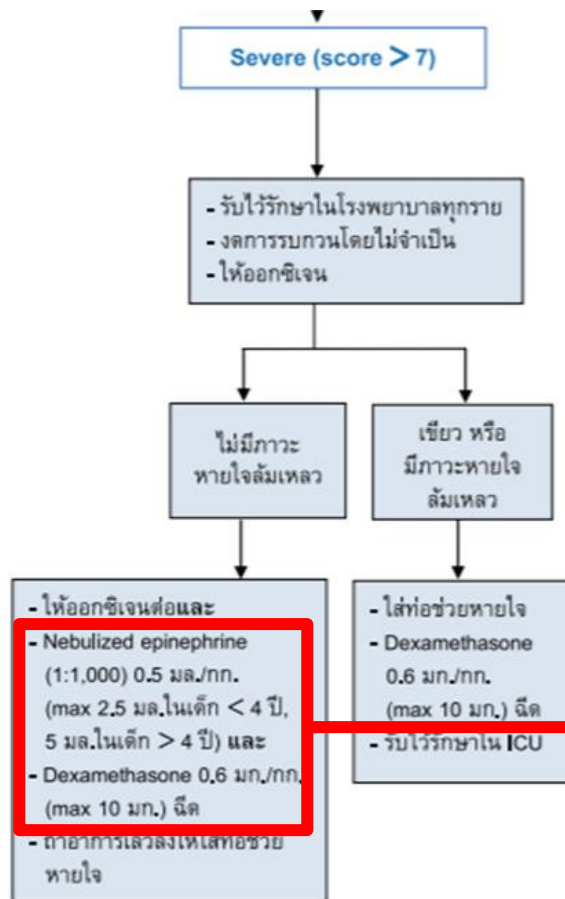


- Dexamethasone 0.15-0.6 มก./กก. กินหรือฉีดครั้งเดียว หรือ prednisolone 1 มก./กก. กินครั้งเดียว
- ให้กลับบ้านได้และรักษาตามอาการ
- ให้คำแนะนำแก่ผู้ปกครอง
- นัดติดตามอาการภายใน 24-48 ชั่วโมง

Moderate (score 4-7)



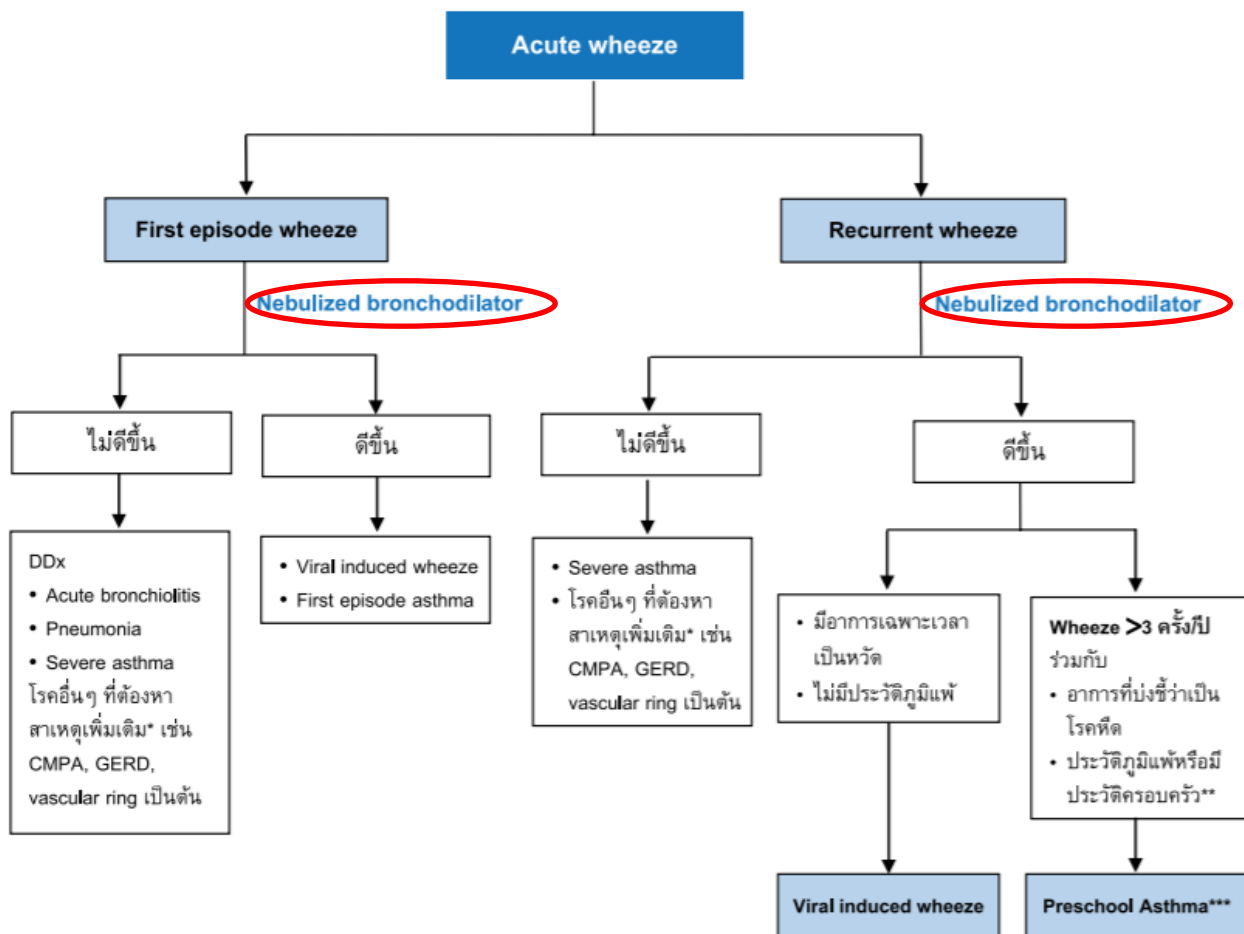
- ให้ออกซิเจน และ
- Nebulized epinephrine (1:1,000) 0.05-0.5 มล./กก. และ
- Dexamethasone 0.15-0.6 มก./กก. กินหรือฉีดครั้งเดียวหรือ nebulized budesonide 2 มก. ครั้งเดียว และ
- ติดตามประเมินอาการผู้ป่วย นานอย่างน้อย 4 ชั่วโมง



**Consider alternative Rx
follow Canadian Society of
Pediatrics**

Adrenaline SC or IM

7.5 to 15 kg:	0.1 mg IM/SC
15 to 30 kg:	0.15 mg IM/SC
>30 kg:	0.3 mg IM/SC



Queensland Paediatric Consensus Statement: Respiratory therapies in ED during the COVID-19 outbreak

Nebulisers

Salbutamol, Ipratropium and Adrenaline administration recommendations	
Salbutamol Ipratropium	<ul style="list-style-type: none">MDI and spacer routinely recommended with/without low flow nasal oxygen.Only use nebulised Salbutamol and Ipratropium in child in extremis on senior advice.
Adrenaline	<ul style="list-style-type: none">Only use nebulised Adrenaline in croup cases if significant stridor at rest and significant work of breathing or hypoxia on senior advice



Seek urgent senior emergency/paediatric approval to administer nebulised Salbutamol, Ipratropium or Adrenaline. **In life-threatening cases DO NOT delay for approval.** Notify in parallel with treatment.



ALERT – Requirements for the administration of nebulised medications

- Attending staff in airborne PPE
- Child in negative pressure room where possible, else in single occupant room with door closed

Queensland Pediatric Consensus statement: April 2020

Mild Disease



Moderate Disease



+ Low Flow
Subnasal O₂

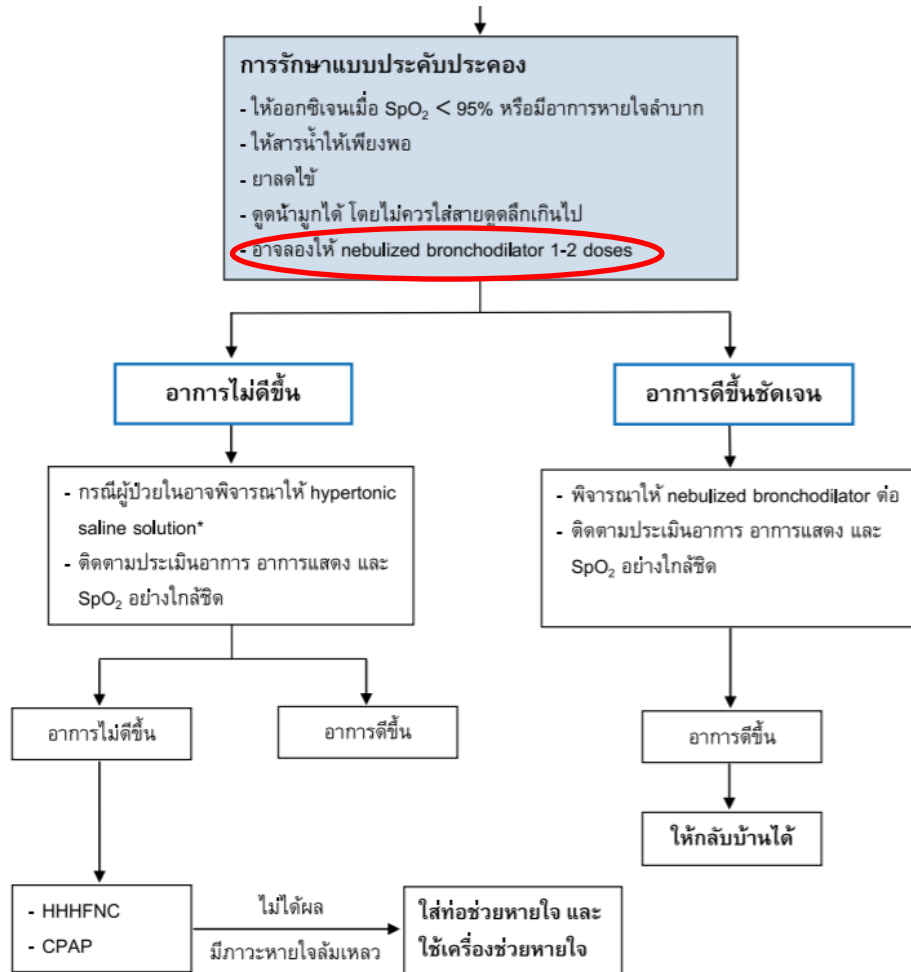
Extremis



Airborne PPE for staff
+ Neg pressure room
if possible

Queensland Pediatric Consensus state

Acute bronchiolitis



Acute bronchiolitis In COVID 19 Era

Any treatment options

- Systemic steroid
- Bronchodilator
- Hypertonic saline
- Oxygenation

Efficacy of dexamethasone injection for acute bronchiolitis in hospitalized children: A randomized double-blind, placebo-controlled trial



- **A single-dose 0.6 mg/kg IM**, dexamethasone injection versus placebo produced a significant:
 - (1) decrease in the time needed for resolution of respiratory distress (hazard ratio 1.56; 95% CI, 1.14–2.13; P = 0.005)
 - (2) decrease in the mean duration of symptoms of 11.8 hr (95% CI, 3.9–19.7; P = 0.004)
 - (3) decrease in the mean duration of oxygen therapy of 14.9 hr (95% CI, 5.3–24.4; P = 0.003)
 - (4) decrease in the mean length of hospital stay of 13.4 hr (95%CI, 2.6–24.2; P = 0.02)

Teeratakulpisarn J et al. Pediatric Pulmonology
2007;42(5):433 - 9

Mild Disease



Moderate Disease



+ Low Flow
Subnasal O₂

Extremis



Airborne PPE for staff
+ Neg pressure room
if possible

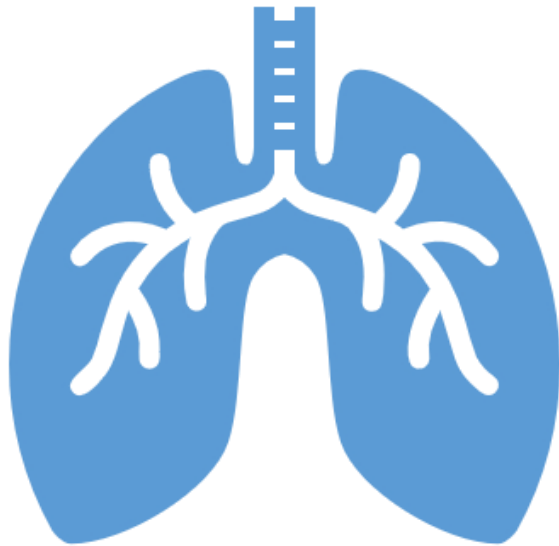
Queensland Pediatric Consensus statement: April 2020



แนวทางการบำบัดรักษาทางระบบหายใจในผู้ป่วยเด็กที่ติดเชื้อ COVID-19
(6 เมษายน 2563)

ศ.พญ.อรุณวรรณ พฤทธิพันธุ์
สมาคมโรคระบบหายใจและเวชบำบัดวิกฤตในเด็ก

www.thaipedlung.org



**If SpO₂ < 92% recommend Low
flow nasal cannula 0.5-6 LPM
If not improve: Oxygen mask
with bag 6-10 LPM**



Diagram 1 - COVID-19 Bag Valve Mask Assembly (applicable to T-Piece also)



Pediatric ward

- **การดูแลผู้ป่วยใน ward**
- **การดูแลสภาพแวดล้อม**
- **Respiratory care**
- **Oxygenation**
- **Nebulized therapy**
- **Chest physical therapy**



Thank U 😊