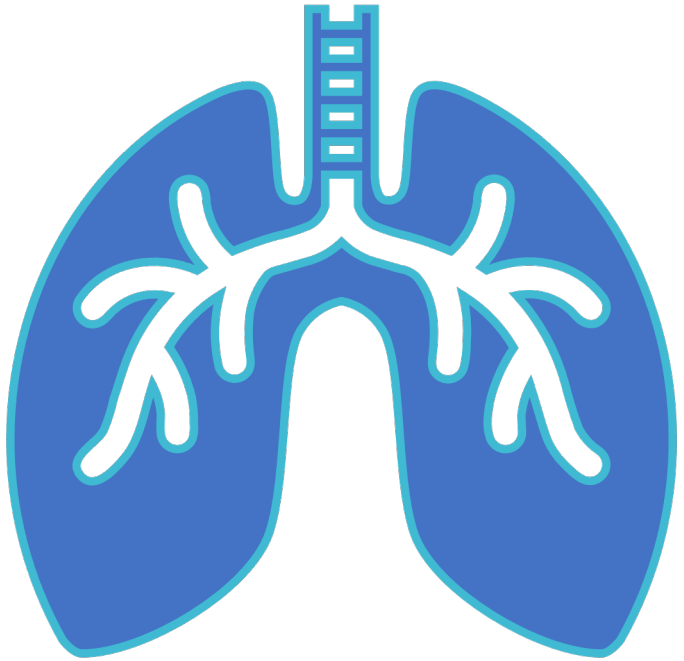

Paediatric Respiratory

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November, 2020

The child with breathing difficulties

- Learning objectives
  - How to assess children with breathing difficulties
  - How to recognize & manage children with breathing difficulties within the 3 D's format
    - **Dangers**
    - **Distress**
    - **Disposition**

Epidemiology

- Most respiratory illnesses are self-limiting, minor infections
- Some present as potentially life-threatening emergencies
  - Underlying co-morbidities – cardiac, lung, metabolic, neurologic
  - Prematurity
- Acute respiratory illness
  - Largest single cause of death <5 yo globally
  - 1.1 million deaths/year (~20%)
  - Most in first 2 years of life

Dangers

- Airway obstruction – upper/lower
- Respiratory distress
- Shock
- Exhaustion/Altered GCS
- Hypoglycaemia

Fear

Pain/discomfort

Distress

Disposition

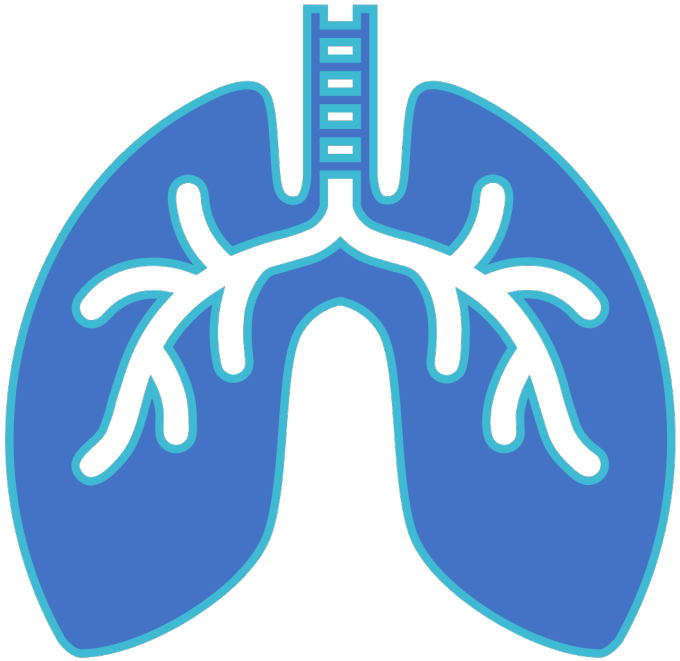
Discussed at end of talk!

Susceptibility

- Severe respiratory illness may result in respiratory failure
  - Infants/young children more susceptible to infection
  - Smaller airways - more easily obstructed
  - More compliant thoracic cage – less support
  - End expiration is close to closing volume in infants
  - Fewer alveoli in early childhood
  - Inefficient respiratory muscles
  - Muscular pulmonary vascular bed – increased vasoconstriction and shunting, ductal opening in early neonates, V/Q mismatch, hypoxia
  - Paradoxical inhibition of respiratory drive in 1-2 months of age – apnoea, hypoventilation with infection
  - Fetal Hb present until 4-6 months of age – O2 given up less readily to tissues

Causes of breathing difficulty in children according to mechanism	
Mechanism	**Cause**
Upper airway obstruction	
Lower airway obstruction	
Disorders affecting lungs	
Disorders around the lungs	
Disorders of the respiratory muscles	
Disorders below the diaphragm	
Increased respiratory drive	
Decreased respiratory drive	

Causes of breathing difficulty in children according to mechanism	
Mechanism	**Cause**
Upper airway obstruction	Croup/epiglottitis Foreign body Anaphylaxis Burns
Lower airway obstruction	Tracheitis Asthma/viral wheeze Bronchiolitis Foreign body Anaphylaxis
Disorders affecting lungs	Pneumonia Pulmonary oedema (eg cardiac)
Disorders around the lungs	Pneumothorax Pleural effusion/empyaema Rib fractures
Disorders of the respiratory muscles	Neuromuscular disorders
Disorders below the diaphragm	Peritonitis Abdominal pain/distension
Increased respiratory drive	DKA Shock Poisoning (eg salicylates) Anxiety/hyperventilation
Decreased respiratory drive	Coma Convulsions Raised ICP Poisoning



Clinical presentations

Respiratory signs

- Cough
- Breathlessness (SOB)
- Stridor
- Wheeze
- Chest pain

Clinical presentations

Non-Respiratory signs

- Fever
- Poor feeding
- Abdominal pain
- Vomiting
- Hypotonia/floppy
- Altered mental status
- Pallor/cyanosis

History

- Noisy breathing – nature of noise
  - High-pitched on inspiration – larynx/trachea
  - Snoring (stertor) – poor airway positioning, pharyngeal obstruction
  - Bubbly/gurgly – secretions
  - Wheeze – expiratory, lower airway obstruction
  - Grunting – small airway closure/alveolar filling, creating own PEEP
- Rapid breathing
- Work of breathing – muscles sucking in, tracheal tug, head bob
- Stopping breathing – apnoeas
- Cool skin, colour change – pallor, cyanosis, mottling
- Oral intake, wet nappies, vomiting, fontanelle
- Decreased GCS – Irritable, Floppy, lethargic, exhausted
- Fevers

Primary assessment & resuscitation

ABCDE Approach

Airway

- Is it patent – child crying/talking
- Is it noisy – stridor, secretions
- If not patent – call for help immediately to secure airway

Primary assessment & resuscitation

ABCDE Approach

Breathing

- Breathing difficulty/low SpO2 = give oxygen and call for help
  - Aim SpO2 >90%
  - If lower flows maintain SpO2 use NP 1-2 L/min
  - If requiring higher flows give 10-15 L/min vial face mask with reservoir bag to provide close to 100% O2 and titrate down
- Significant work of breathing
  - Consider HFNP (Airvo)
- Hypoventilation, slow RR or weak effort
  - Support breathing with BVM and call for help

Primary assessment & resuscitation

ABCDE Approach

Circulation

- Reduced fluid intake, vomiting
  - Well enough to trial **oral** fluids, antiemetic?
  - **Nasogastric tube**
    - Rapid rehydration– 15 mL/kg/hr for 4 hrs
    - 2/3 maintenance continuous
  - **IV fluids**
    - Fluid bolus - 10 mL/kg NaCl 0.9%
    - Shock – 20 mL/kg NaCl 0.9%
    - 2/3 Maintenance
  - **Bloods** – FBC, U&Es + gas/BSL/culture

Primary assessment & resuscitation

ABCDE Approach

Disability

- Altered mental state
  - AVPU
  - GCS
  - Don't Ever Forget Glucose
    - 2 mL/kg 10% Dextrose

Primary assessment & resuscitation

ABCDE Approach

Exposure

- Rashes
- Secondary survey
- Hs & Ts

Secondary Assessment & key features

- Inspiratory noises – upper airway obstruction
- Expiratory noises – lower airway obstruction
- Fever without stridor/wheeze – suggests pneumonia
- Signs of heart failure – congenital or acquired heart disease
- Focused history
  - Previous 24 hours
  - Significant previous illness/birth history ?prem
  - Allergies
  - Rashes
  - Ingestion – toxins/FB

Stridor

Causes of stridor		
Incidence		
Very Common		
Less common		
Rare		

Stridor

Causes of stridor		
Incidence	Diagnosis	Clinical features
Very Common	Croup – viral laryngo-trachea-bronchiltis	Coryzal illness, barking cough, mild fever, hoarse voice
Less common	Foreign body aspiration Anaphylaxis	Sudden onset, history of choking Sudden onset, urticaria, facial swelling, history of exposure to allergen
Rare	Epiglottitis Bacterial tracheitis Retropharyngeal/peritonsillar abscess EBV Diptheria Trauma Inhalational injury/burns	Septic looking, drooling, muffled voice, absent cough Harsh cough, chest pain, septic looking Septic looking, drooling Sore throat, tonsillar enlargement Unimmunised, travel to endemic area Neck swelling, crepitus, bruising Facial burns, peri-oral soot.

Case 1

- 3 yo boy
- 1 day of coryzal illness.
- Woke in the night with barking cough, noisy breathing and very distressed.

Case 1

- Diagnosis
- Differentials
- Assessment
- Management
- Disposition

Specific management – Croup

- Keep child calm
- On parent's lap if possible
- Assess severity using Croup BCB
- Dexamethasone
- If severe
  - Call for help
  - O2 6L/min + Adrenaline neb for severe croup

Red Flags → Senior Medical or Paediatric Registrar review without delay

- ☐ **CAT "Severe" or Hypoxia (Sats < 92%) or PEWS ≥ 10 → *Start Severe Pathway***
- ☐ Sudden onset, no prodromal illness, history of choking (? Foreign body)
- ☐ Urticarial rash (? Anaphylaxis) ☐ Allergies associated with Anaphylaxis in the past
- ☐ Not immunised (? Epiglottitis) ☐ High fever and toxic appearance (? Bacterial Tracheitis / Epiglottitis)
- ☐ Known syndromes (e.g. Down Syndrome) or airway issues (Laryngo-tracheo malacia, Haemangiomas)

Croup Assessment Tool (CAT)
If features from more than one category "mild", "moderate" or "severe" are present, score the highest category

	Mild	Moderate	Severe
Behaviour:	Normal	Some or intermittent irritability	Increasing irritability or lethargy
Stridor:	Barking cough Stridor only when active or upset	Some stridor at rest	Stridor present at rest
Respiratory rate:	Normal	Increased	Marked increase or decrease
Accessory muscle use:	None or Minimal	Tracheal tug Nasal flaring Moderate chest wall retraction	Tracheal tug Nasal flaring Marked chest wall retraction
Hypoxia or oxygen requirement:	None	None or Minimal	Saturations < 94%

Severe Pathway → *move to Resus and call for help*

Minimise distressing interventions and institute calming measures
High flow oxygen
Initial treatment:
- ↳ **1:1000 Adrenaline nebulised 0.5 ml/kg (max 5 mg or 5 ml) (not S.O.)**
- ↳ **Oral Dexamethasone 0.6 mg/kg (max 12 mg)**

Ongoing management directed by Medical Staff:
- ↳ Repeat Adrenaline as required every 10 minutes

Discuss with PICU if severe stridor recurs after treatment
If no improvement after initial treatment consider alternative diagnosis

Specific management – Bacterial tracheitis

- Staph Aureus, Group A Strep, H. Influenzae
- Copious purulent secretions and mucosal necrosis
- Toxic, high fevers, progressive upper airway obstruction
- Croupy cough, no drooling, longer history cf epiglottitis

- Call for help
- 80% need intubation and ventilation support
  - In theatre with experienced anaesthetist is the safest option
- Resuscitate (ABCDE)
- Give antibiotics – cefotaxime or ceftriaxone + flucloxacillin

Case 2

- 5 yo girl
- 2-3 days Fevers >39 deg
- Snoring at night
- Poor oral intake, drooling
- Pale and lethargic

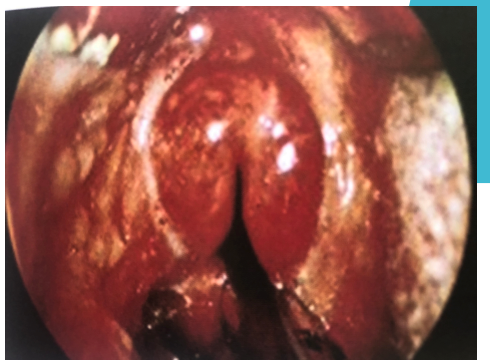
Case 2

- Diagnosis
- Differentials
- Assessment
- Management
- Disposition

Specific management - Epiglottitis

- H. Influenzae, Staph Aureus, Group A Strep,
- Intense swelling of epiglottis and surrounding tissues
- Acute onset, Toxic, high fevers
- Soft inspiratory stridor, drooling, reluctant to speak due to sore throat. Cough is minimal/absent
- Rapidly increasing respiratory difficulty

- Call for help
- Likely to need early intubation with senior anaesthetist in theatre
- Resuscitate (ABCDE)
- Give antibiotics – cefotaxime or ceftriaxone



Case 3

- 2 yo boy
- Playing with lego in the living room ½ hr ago
- Choking episode – called ambulance
- Now has noisy breathing

Case 3

- Diagnosis
- Differentials
- Assessment
- Management
- Disposition

Specific management - Foreign Body

- Suspect in witnessed choking episodes
- May not have the history!
- Cannot be excluded with normal physical exam/CXR
- Laryngo-bronchoscopy needed if history suggestive of FB

- Keep child calm
- Listen for stridor, asymmetric breath sounds, unilateral wheeze
- CXR – inhalation and exhalation views
- Discuss with ENT
- If immediate life threat – call for help, direct laryngoscopy with Magills forceps, APLS

Button Battery = EMERGENCY laryngoscopy under ENT

Case 4

- 8 yo girl
- Known allergy to shellfish
- Had seafood curry at a friends
- Urticaria, lip/facial swelling
- Noisy breathing

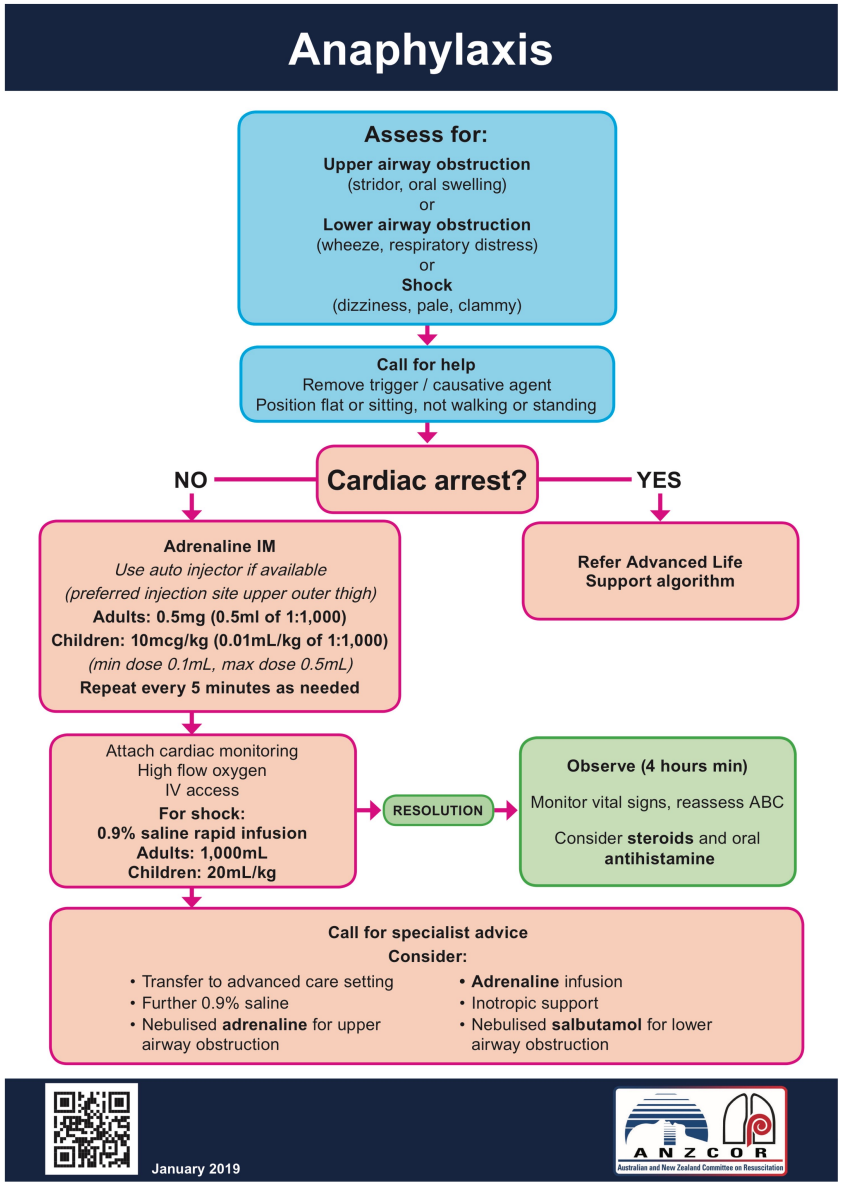
Case 4

- Diagnosis
- Differentials
- Assessment
- Management
- Disposition

Specific management - Anaphylaxis

- Potentially life-threatening, immunologically mediated
- Respiratory or circulatory effects
- Upper or lower airway obstruction
- Stridor/wheeze usually preceded by prodromal symptoms
  - Flushing, itching, facial swelling, urticaria
  - May also have abdo pain, diarrhoea, shock
- Can be predicted in children with a history of previous anaphylaxis or increasingly severe reaction, asthma, beta-blockers
- Measurement of serum tryptase at presentation may be helpful in confirming diagnosis

Specific management - Anaphylaxis



Specific management – Asthma Wheeze >1 yo

- Historical features associated with more severe/life-threatening asthma/wheeze
  - Long duration of symptoms
  - Regular night waking
  - Poor response to treatment already given
  - Severe course of previous attacks
    - IV therapy
    - Oxygen requirement
    - Admissions to PICU

Case 5

- 7 yo boy with history of wheeze
- 2-3 days of mild cough/cold
- Past 24 hours worsening wheeze and WOB despite spacers

Case 5

- Diagnosis
- Differentials
- Assessment
- Management
- Disposition

Specific management – Asthma Wheeze >1 yo

- Assess clinical signs as per the Wheeze >1 yo BCB
- Some children with severe wheeze do not appear distressed
  - Silent chest
  - Quiet, subdued, exhausted
- Younger children more difficult to assess

Red Flags → Senior Medical or Paediatric Registrar review without delay

- ☐ SS = 6 or PEWS ≥ 10 → *Start Severe Pathway*
- ☐ Poor response to Salbutamol prior to arrival in ED
- ☐ Possible FB inhalation
- ☐ Previous PICU admit
- ☐ Cardiac disease
- ☐ Other Respiratory disease (CF, Bronchiectasis)
- ☐ Allergies associated with anaphylaxis in past
- ☐ Urticarial rash

Asthma Severity Score Tool (SS) Add wheeze score and work of breathing score

Wheeze		Work of breathing	
None	0	None	0
Expiratory	1	Mild	1
Inspiratory and Expiratory	2	Moderate	2
Heard without stethoscope	3	Severe	3
Silent chest	3	Respiratory fatigue	3

Severe Pathway (SS = 6) → *move to Resus and call for help*

Nursing Actions:	• High flow oxygen, attach monitoring equipment • SALBUTAMOL 5 mg + IPRATROPIUM BROMIDE 250 mcg nebulised • Inform Paediatric Team • IV access • Print out Emergency Calculator Treatment sheet
Medical Staff:	• Follow Severe and Life Threatening Asthma < 15 years algorithm • Consider IV Magnesium Sulphate early • Consider high flow nasal oxygen (Airvo) at 2l/kg/min

Discuss with PICU if poor respiratory effort (fatigued) or decreased conscious level or on Airvo support at FiO2 > 0.4.

Specific management – Asthma Wheeze >1 yo

Markers of severity				
	Mild	**Mod**	**Severe**	**Life-threatening**
Wheeze	Scattered, inspiratory	Wide-spread, inspiratory	Wide-spread, Biphasic Heard without stethoscope	Silent chest
RR	Normal	Mildly elevated	>30 (>5 yo) >50 (2-5 yo)	Low RR
WOB	None-mild	Mild-mod	Severe	Exhaustion
SpO2	>95%	90-95%	<90%	<80%
Pulse	Normal	Mild tachycardia	Significant tachycardia	Severe tachycardia or bradycardia
Talks in	Sentences	Phrases	Words	Unable to speak
Physical exhaustion	No	No	Yes Paradoxical chest wall movement	Low RR/agonal
Altered GCS	No	No	Drowsy	Depressed Agitated

Specific management – Asthma Wheeze >1 yo

- Assess ABC
- Call for help
- Give high flow O2
- Aim SpO2 >90 %
- **Beta-agonist** (salbutamol)

  x 3 Q20 min
  - Spacer – 6 puffs
  - Nebuliser – 2.5 mg (<5 yo) or 5 mg (>5 yo)
- **Anticholinergic** (Ipratropium)
- x 3 Q20 min
  - Spacer – 4 puffs
  - Nebuliser – 250 mcg
- **Steroids**
  - Prednisolone >5 yo – 1 mg/kg max 40 mg
  - Hydrocortisone IV – 4 mg/kg max 200 mg

Specific management – Asthma Wheeze >1 yo

- CXR not indicated unless not responding to treatment as expected and needing IV therapy
- If moving on to IV therapy
  - Bloods – FBC, U&Es + gas/BSL/culture

Case 6

- 3 month old
- Term
- 1 day of coryza/cough, 2 yo sibling has URTI
- Today increasing WOB, noisy breathing
- Not feeding well, 2 x wet nappies

Case 6

- Diagnosis
- Differentials
- Assessment
- Management
- Disposition

Specific management – Bronchiolitis

- Most common serious respiratory infection
- 10% affected in infancy with 2-3% admitted to hospital
- 90% aged 1-9 months, unusual after 1 yo
- Respiratory Syncitial Virus (RSV) 60-70%
  - Parainfluenza 1-2-3
  - Influenza A-B
  - Human metapneumovirus
  - Adenovirus
- Secondary bacterial infection is uncommon
- Fever, coryza, dry cough, increasing SOB/WOB, feeding difficulties
- Wheezing/crackles on auscultation
- Recurrent apnoea serious and potentially fatal complication
  - Age < 6 weeks
  - Premature infants
  - Co-morbidities – immune deficiency, CHD, CLD

Specific management – Bronchiolitis

Bronchiolitis characteristic findings	
Sign	**Finding**
Tachypnoea	>50 breaths/min
Recession	Subcostal, intercostal
Cough	Sharp, dry
Hyperinflation of chest	Sternum prominent, liver depressed
Tachycardia	>140 bpm
Crackles	Fine, end-expiratory
Wheeze	High pitched, expiratory > inspiratory
Colour	Cyanosis/pallor
Breathing pattern	Irregular, recurrent apnoea

Specific management - Bronchiolitis

- Management is primarily supportive
  - Assess ABC
  - Assess severity as per BCB
  - Call for help
  - Suctioning nasal secretions
  - Oxygen, respiratory support
    - Aim SpO2 >90%
    - Low flow O2 vs airvo
    - CPAP
    - Intubation/ventilation – 2%
  - Replace fluids
    - Oral
    - NGT
    - IV

Red Flags → Senior Medical or Paediatric Registrar review without delay

- ☐ **BAT "Severe" or PEWS ≥ 10 → *Start Severe Pathway***
- ☐ Temp > 39°C or looks toxic
- ☐ Heart rate > 200
- ☐ Previous PICU admit
- ☐ Known cardiac or airways issues
- ☐ Apnoeas or fatigued
- ☐ Pertussis contact
- ☐ Chronic Lung Disease or on home oxygen
- ☐ Corrected gestation < 52 weeks or < 3m age post term

Bronchiolitis Assessment Tool (BAT)

If features from more than one category "mild", "moderate" or "severe" are present, score the highest category

	Mild	Moderate	Severe
Wheeze:	None or end expiratory	Entire expiration	Inspiratory and expiratory
Feeding:	Normal	Less than usual but > ½ of normal. Frequently stops feeding	Not interested or not able < ½ of normal. Gasping or coughing
Oxygen requirement:	None	May require oxygen	Requires oxygen (Sats < 92%)
Indrawing:	None or Mild	Intercostal and Tracheo-sternal	Severe with nasal flaring
Behaviour:	Normal	Some or intermittent irritability	Irritability or lethargy or apnoeas
Hydration:	Normal	Dehydration present	Dehydration present

Hydration Assessment Tool

Features suggesting dehydration when there is a history of poor intake.	• Thirsty • Absent tears • Sunken eyes • Sunken fontanelle	• Reduced urine output • Recent weight loss • Decreased capillary refill

Severe Pathway → *move to Resus and call for help*

Nursing Actions:
- Suction and clear nasal passages
- Oxygen to keep Sats > 92%
- Inform Paediatric Team
- Attach monitoring equipment
- Insert NG Tube and decompress stomach - Stop NG Feeds

Medical Staff:
- Consider high flow nasal oxygen (Airvo) at 2 l/kg/min
- Look for shock and treat with IV fluid bolus
- Consider other diagnoses e.g. VSD with failure

Discuss with PICU if Saturations not maintained or apnoeas observed

If poor respiratory effort or decreased conscious level consider intubation and ventilation at any stage

Specific management – Pneumonia

- Globally – 13% of deaths in children <5 yo
- Particular risk in those with comorbidities
- Wide spectrum of pathogens
  - Different organisms for different age groups
  - Viral decreases with increasing age, typically peak in autumn/winter
  - Bacterial remains static across all ages, less seasonal fluctuation
- Cough, fevers, tachypnoea, may have recession, lethargy
- May have abdominal pain, vomiting

Case 7

- 10 yo girl
- 3 days of cough, cold, fever
- Today vomiting x 5, ongoing fevers
- Breathing rapid

Case 7

- Diagnosis
- Differentials
- Assessment
- Management
- Disposition

Specific management – Pneumonia

Pathogens by age	
Age	**Pathogen**
Newborn	*E. Coli* *Group B Strep* *Listeria* *Chlamydia*
Infancy	RSV *Strep pneumoniae* *Haemophilus influenzae* *Staph aureus*
School age	*Mycoplasma pneumoniae* *Strep pneumoniae* *Chlamydia pneumoniae*

Consider *Bordetella pertussis* (whooping cough) in infants and unimmunized children.

Specific management – Pneumonia

- Assess ABC
- Call for help
- Oxygen, respiratory support
  - Aim SpO2 >90%
  - NP vs mask
- Replace fluids
  - Oral
  - NGT
  - IV (bloods + gas/BSL/culture)
- Antibiotics
  - Amoxycillin
    - PO 30 mg/kg
    - IV 50 mg/kg
  - Cefotaxime
    - If septic component or young infants
  - Flucloxacillin
    - If Staph suspected
  - Macrolide
    - Atypical pneumonia/pertussis suspected

Specific management – Pneumonia

- In older children who are well, no O2 requirement and tolerating orals
  - May be treated at home on PO antibiotics with GP follow up
- In infants, children with sepsis, significant WOB, O2 requirement, not tolerating orals/dehydration
  - Inpatient treatment with IV or PO antibiotics
- Children with neuromuscular or other significant comorbidities may require inpatient treatment.

Specific management – Pneumonia

- **Chest X-Ray**
  - Lobar consolidation
  - Widespread bronchopneumonia
  - Cavitation of the lung (rare)
  - Pleural effusions
    - May organize to empyaema

Disposition

- **Home**
  - Well child with no O2 requirement tolerating orals
  - Car, phone, lives nearby
  - Non-smoking environment
- **Inpatient General Paediatrics**
  - O2 requirement, airvo
  - Not tolerating orals, requiring rehydration
  - Social concerns
- **PICU**
  - Severely unwell
  - Deteriorating – increasing O2 requirement, WOB, decreasing GCS, shock

References

- Advanced Paediatric Life Support, Sixth Edition Australia and New Zealand. Ed. M Samuels, S Wieteska. 2019.
- Waitemata DHB Best Care Bundles. Croup, Wheeze >1 yo, Bronchiolitis. Available on CeDs.
- Starship Clinical Guidelines. M Shepherd, G Williams. https://www.starship.org.nz/guidelines/pneumonia. Last update 29 July 2019.