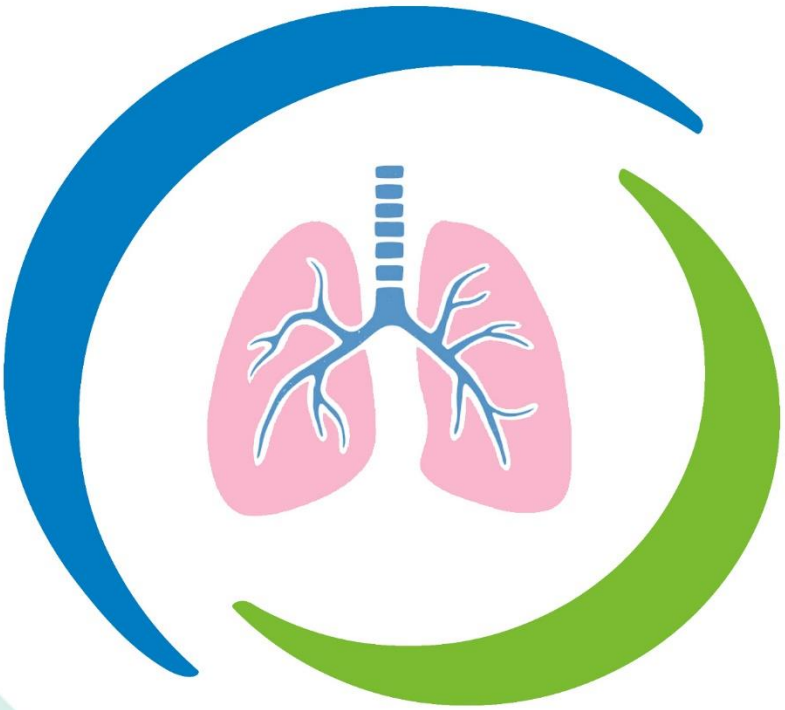
Pediatric Pulmonology Protocol of EHA



First Edition 2024

Egyptian Clinical Practice Guidelines

in

Pediatric Pulmonology

for

Egypt Healthcare Authority

First Edition

2024

Prepared By

Working Group for Development of

Egyptian Clinical Practice Guidelines

in

Pediatric Pulmonology

for

Egypt Healthcare Authority

Executive Committee

1. Prof. Eman Mahmoud Fouda:(Head of the Committee) Professor of Pediatrics, Ain Shams University

2. Prof. Hala Hamdi: Professor of Pediatrics, Cairo University

3. Prof. Mona Mohsen Elattar: Professor of Pediatrics, Cairo University

4. Prof. Tarek Hamed: Professor of Pediatrics, Zagazig University

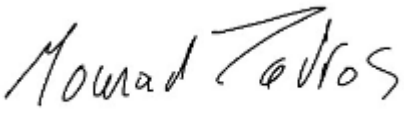
5. Dr. Huda Karam: Pediatric Specialist, Moderator & coordinator of Medical Advisory Council of Egypt Healthcare Authority (EHA)

Intellectual Property Rights

Supervised & Revised By

➢ ***General Doctor/ Mourad Alfy Ramzy Tadros***

- MD, FRCPCH(UK), MRCPI(Dublin)
- Consultant Pediatrician of Egyptian Military Medical Services.
- Professors of Pediatrics Military Medical Academy
- Head of Training Committee of Pediatrics of Egyptian Military Medical Board
- Consultant Pediatrician of the Medical Advisory Council of Egypt Healthcare Authority (EHA).



Reviewed By

1. Dr. Hala Adel: Pediatric Consultant, Moderator & coordinator of Medical Advisory Council of Egypt Healthcare Authority (EHA)

2. Dr. Huda Karam: Pediatric Specialist, Moderator & coordinator of Medical Advisory Council of Egypt Healthcare Authority (EHA)

Cover Designed & Content Edited By

➢ ***Mr. Bassam Sayed:*** Technical Officer at Medical Advisory Council of Egypt Healthcare Authority (EHA)

PREFACE

The Egyptian Clinical Practice Guideline in pediatric pulmonology represent an evidence-based national perspective for the management of most common respiratory presentations in children that would be both clinically relevant and practically feasible for implementation. These guidelines present recommendations for clinical practice as adapted from ACCP 2006-2020, ERS 2019 & KAAACI 2018. We hope this report to be a useful resource in the management of chronic cough in children.

This guideline intends to assist the practitioners, namely; pediatricians, primary health care (PHC) physicians, family practitioners, nurses and clinical pharmacists to apply the best available evidence-based researches to clinical decisions about the management of in children below 14 years

This ECPG does not intend to serve as a standard of medical care. Standards of care should be based on all the clinical data available for an individual case and are subjected to changes as scientific knowledge and technology advance in patterns of care evolve .

The ECPG recommendations will neither ensure a successful outcome in every case nor include all the proper methods of care. Also, they do not exclude other acceptable methods of care aimed at the same results .

The ultimate judgment must be made by the appropriate physician who is responsible for clinical decisions regarding a particular clinical procedure or treatment plan. This judgment should only be made following discussion of the options with the patient, in light of the diagnostic and treatment choices available. However, it is advised that significant departures from the ECPGs or any local CPGs derived from it should be fully documented in the patient's case notes at the time the relevant decision is taken.

Finally, we wish the best for all our patients and their families who inspired us. It is for them this work is being finalized

Members of the Working Group

For Development of the Egyptian Clinical Practice Guideline

In Pediatric Pulmonology

Table of Contents

Scope and Purpose

Disease/Condition:

Management of common respiratory illness in children < 14 years.

Guideline Category:

Management (Diagnosis and Treatment)

Clinical Specialties:

- Pediatrics.
- Pediatric pulmonology.
- Infectious diseases.
- Primary health care.
- Family practitioners.

Intended User (target users):

- Physicians.
- Pediatricians.
- Primary Health Care (PHC) Physicians.
- Family Practitioners.
- Nurses .
- Clinical Pharmacist.

Guidelines Objectives:

- Optimizing the medical management of children with common respiratory illness.
- Providing optimal pharmacotherapy to prevent or minimize adverse effects of therapy.

List of Abbreviations

ACCP	*American collage of chest physicians*
ACEI	*Angiotensin-converting enzyme inhibitors*
AFCM	*Armed Forces College of Medicine*
CCGAG	*Chronic Cough Guideline Adaptation Group*
CPGs	*Clinical Practice Guidelines*
CT	*Computed tomography*
CVA	*Cough variant asthma*
EBCPG	*Evidence Based Clinical Practice Guideline*
EBM	*Evidence-based medicine*
EPCG	*Egyptian Pediatric Clinical Guidelines*
EPG	*Egyptian Pediatric Guidelines*
ERS	*European Respiratory Society*
FeNO	*Fractional exhaled nitric oxide*
GER	*Gastro-esophageal reflux*
GERD	*Gastro-esophageal reflux disease*
GOR	*Grade of Recommendation*
H1RAs	*Histamine 1-receptor antagonists*

HRCT	*High resolution computed tomography*
KAAACI	*Korean Academy of Asthma, Allergy and Clinical Immunology*
LOE	*Level of Evidence*
LTRAs	*Leukotriene receptor antagonists*
MTB/ RIF	*Mycobacterium tuberculosis complex resistance to rifampicn*
OSA	*Obstructive sleep apnea*
PHC	*Primary Health Care*
PBB	*Protracted bacterial bronchitis*
pH	*Potential of hydrogen*
PIPOH	*Patients, Interventions, Professionals, Outcomes, Healthcare settings*
RCT	*Randomized controlled trial*
TB	*Tuberculosis*

Chronic Cough

Introduction and Background:

- Chronic cough is defined as the presence of daily cough of more than 4 weeks duration in children aged <14 years old. It has been divided into specific and nonspecific cough. Specific cough is usually associated with an underlying disease and non-specific cough indicates prolonged cough in the absence of any symptoms, signs, history, or laboratory findings indicating a specific diagnosis (specific cough pointers).

- Chronic cough is common in the community and causes significant morbidity. It is a prevalent problem in about 10% of the general populations worldwide and poses a considerable socioeconomic burden and serious impairment to quality of life (QOL) of children and their parents.

- Children with chronic cough may experience physical pain, sleep disturbance, loss of school productivity, and social isolation for several months to years and successful management requires a treatment program based on accurate diagnosis and understanding of the cough etiology.

Table (1): Specific Cough Pointers

Abnormality	Examples of Etiology
Symptoms or Signs Auscultatory finding	 Wheeze Crepitations-any airway lesions (from secretions) or parenchymal disease such as interstitial disease
Cardiac abnormalities	Associated airway abnormalities, cardiac failure, arrhythmia
Chest pain	Arrythmia, pleural disease, asthma
Chocked	Foreign body inhalation
Dyspnea or tachypnea	Any pulmonary airway or parenchymal disease
Chest wall deformity	Any pulmonary airway or parenchymal disease
Digital clubbing	Suppurative lung disease
Daily wet/ productive cough	Protracted bacterial bronchitis, suppurative lung disease, recurrent aspiration, atypical infections, TB, diffuse panbronchiolitis
Exertional dyspnea	Any airway or parenchymal disease

Abnormality	Examples of Etiology
Facial pain/purulent nasal discharge	Chronic sinusitis,(protracted bacterial bronchitis), primary ciliary dyskinesia
Feeding difficulties	Neurological diseases including palatopharyngeal incoordination
Growth failure	Such as Cystic fibrosis
Hoarse voice/stridor	Laryngeal cleft/problems, airway abnormalities
Hemoptysis	Suppurative lung disease, vascular abnormalities
Hypoxia/cyanosis	Any airway or parenchymal disease, cardiac disease
Neurodevelopmental abnormalities	Aspiration lung disease
Recurrent pneumonia	Immunodeficiency, atypical infections, suppurative lung disease, congenital lung abnormalities, trachea-esophageal H-type fistula
Recurrent infections	Immunodeficiency
Previous history of chronic lung disease, esophageal disease (neonatal lung disease, esophageal atresia	Multiple causes (eg, second H-type fistula, bronchiectasis, aspiration, asthma)
Wheeze-monophonic	Large airway obstruction (eg, from froing body aspiration, malacia, and/or stenosis, vascular ring, lymphadenopathy, and mediastinal tumors)
Wheeze-polyphonic	Asthma, bronchiolitis obliterans, bronchiolitis
Tests • Chest radiograph (other than peribronchial changes) • Spirometry abnormalities	Any cardiopulmonary disease

Clinical History and Examination:

- The etiology of chronic cough in children can accurately be identified by observation, a careful history, and progressing to appropriate tests and therapeutic trials based on pointers obtained in the history. The impact of cough should be assessed either by recording simple measures such a cough scores out of 10 (Appendix) or by more detailed, validated measures of cough quality of life (LCQ or CQLQ).

Etiology and Differential Diagnosis:

Cause	Remarks
Asthma	• Cough is commonly associated with recurrent wheezing • Asthma can be manifested only with cough and is then called cough-variant asthma or cough-dominant asthma. • A therapeutic trial of SABA and ICS should be offered if diagnoses of asthma is being considered
Cyctic fibrosis	• Clubbing and failure to thrive • Universal newborn screening • Diagnosis is by measurement of sweat chloride concentration and genetic identification
Primary ciliary dyskinesia	• Chronic wet cough • History of transient neonatal distress is common • Begins in infancy and persists • History of recurrent attacks of otitis media & hearing impairment • Diagnosis by electron microscopy and high-speed video-microscopy analysis
Bronchiectasis	• Bronchiectasis can occur with cystic fibrosis, primary ciliary dyskinesia, and in some patients with protracted bacterial bronchitis Bronchiectasis unrelated to chronic lung disease is also seen • Diagnosis by radiology confirmed by computed tomography
Pertussis (whooping cough)(pertussis like illness)	• Frequent spasms of coughing followed by nausea or vomiting, cyanosis or apnea . like the barking cough
Tracheomalacia or trachea-broncho-malacia	• Occasionally cause chronic cough • Barking quality • But persists during sleep, unlike habit cough. • Diagnosed only by bronchoscopy performed with light sedation so that dynamic movements can be visualized
Protracted bacterial bronchitis (PBB)	**Diagnosed clinically by:** **1)** Presence of continuous chronic (>4 weeks' duration) wet or productive cough; **2)** Absence of symptoms or signs (i.e. specific cough pointers) suggestive of other causes of wet or productive cough; and **3)** Cough resolved following a 2–4-week course of an appropriate oral antibiotic. Diagnosed as PBB-micro by the contents of a broncho-alveolar lavage
Habit cough (tic cough)	• Now labled as somatic cough disorder • Dagnosis should only be made after an extensive evaluation

Cause	Remarks
Postnasal drip syndrome/Upper airways cough syndrome (UACS)	• UACS acting as a trigger for cough hypersensitivity although the mechanism remains obscure
Foreign body aspiration	• Causes localizing auscultatory findings. • History of sudden shocking
Medications and Adverse Events	As a side effect of angiotensin converting inhibitors (ACEI), asthma medications, immediately after inhalation psychostimulant medications (e.g. dextro-amphetamine resulting in new onset tics)
Cardiac causes	Associated with specific manifestations (cough pointers)
Immunodeficiency	Two or more of these warning signs should alert clinician to the possibility of primary immunodeficiency and merit further assessment (Appendix)
Gastro-esophageal reflux disease (GERD)	• GIT manifestations must be present • (GERD is not commonly identified as the cause of pediatric chronic cough
Otogenic etiology Arnold's nerve reflex	Uncommon cause of chronic cough • The ears should always be examined for the presence of any foreign material

Investigations:

- The investigation and therapeutic trials should include those for common cough-triggering conditions (rhinitis, rhinosinusitis, asthma, eosinophilic bronchitis, and GERD) as chest X-rays, spirometry, computed tomography, flexible bronchoscopy and bronchoalveolar lavage, Other investigations include barium swallow, video fluoroscopic evaluation of swallowing, echocardiography, complex sleep polysomnography and immunological studies.

Treatment of Chronic Cough in Children:

- All children with chronic cough should be carefully assessed, as chronic cough may be due to a serious underlying condition (e.g. inhaled foreign body). In addition to etiology-based management, it is prudent that children with chronic cough receive common management interventions as cessation of exposure to environmental tobacco smoke and other environmental pollutants.
- The present clinical practice guideline aims to address major clinical questions regarding, practical diagnostic tools for specific and nonspecific chronic cough. Also, available therapeutic options for chronic cough in children are present.

Notes:

- For patients seeking medical care complaining of cough, estimating the duration of cough is the first step in narrowing the list of potential diagnoses.
- History should include cough characteristics and the associated clinical history such as using specific cough pointers as well as symptoms of red flags or other potential life-threatening symptoms and if present.
- Exposure to airborne irritants (e.g. tobacco exposure, combustions, traffic related exposure etc.), allergens or infection may be a reason for dry chronic cough.
- In unexplained or unresponsive chronic cough, obstructive sleep apnea should be included in the differential diagnosis.
- Detailed history of drug intake is needed including ACEI and other drugs such as bisphosphonates or calcium channel antagonists and prostanoid eye drops.
- An empirical approach aimed at treating upper airway cough syndrome due to a rhinosinus condition, gastroesophageal reflux disease and/or asthma should not be used unless other features consistent with these conditions are present.
- Cough variant asthma (CVA) was originally described as asthma with cough as the sole symptom and where treatment with bronchodilators improved coughing.
- Patients with cough with or without fever, night sweats, hemoptysis, weight loss and/or contact with TB case and who are at risk of pulmonary TB.
- The clinician should recommend chest radiography, but not routinely perform a chest CT in patients who have normal physical examination and chest X-ray.
- The clinician should recommend spirometry (pre and post β2 agonist) when age is appropriate and if diagnosis of asthma is likely.

- The clinician should suggest undertaking tests for evaluating recent Bordetella pertussis infection when pertussis is clinically suspected (if there is post- tussive vomiting, paroxysmal cough or inspiratory whoop).

- Additional test should be individualized and undertaken according the child's clinical symptoms and signs like Mantoux, bronchoscopy and cultures.

- The clinician should recommend evaluation of the immunologic competence in presence of criteria suspicious of immunodeficiency.

❖ **See Page. 38** ***(Ten Warning Signs of Primary Immunodeficiency- Appendix)***

- When risk factors for asthma are present, a short (2-4 weeks) trial of 400 microgram/day of beclomethasone equivalent, and re-evaluated.

- For PBB two weeks of antibiotics targeting the common respiratory bacteria (Streptococcus pneumoniae, Haemophilus influenzae, Moraxella catarrhalis) and depending on the local antibiotic sensitivities.

  - ✓ When the wet cough persists after2 weeks of appropriate antibiotics, consider treatment with an additional 2 weeks of the appropriate antibiotic (Amoxicillin Clavulanic acid).
  - ✓ When the wet cough persists after 4 weeks of appropriate antibiotics, further investigations as flexible bronchoscopy with quantitative cultures and sensitivities with or without chest CT) can be undertaken

Croup

Definition:

Croup is a common respiratory illness of the larynx, trachea, and bronchi characterized by barking cough, often accompanied by inspiratory stridor, hoarseness, and respiratory distress.

Diagnosis:

Croup is primarily a clinical diagnosis, with typical findings of abrupt onset of a barking cough, inspiratory stridor, and hoarseness. Many patients will also have dyspnea and fever.

Levels of Severity for Children with Croup:

Mild:

- Occasional barky cough.
- No audible stridor at rest.
- No to mild suprasternal and/or intercostal indrawing.

Moderate:

- Frequent barky cough.
- Easily audible stridor at rest.
- Suprasternal and sternal wall retraction at rest.
- No or little distress or agitation.

Severe:

- Frequent barky cough.
- Prominent inspiratory stridor.
- Marked sternal wall retractions.
- Significant distress and agitation.

Impending respiratory failure:

- Barky cough (often not prominent).
- Audible stridor at rest (occasionally hard to hear).
- Sternal wall retractions (may not be marked as respiratory failure progresses).
- Lethargy or decreased level of consciousness.
- Often dusky appearance without supplemental oxygen.

Management:

Emergency Care:

General Measures:

- Provide physical comfort**,** avoid agitating the child with unnecessary procedures.
- humidified oxygen to children who are in respiratory distress.
- Mist therapy **HAS NOT** been shown to have any measurable benefit.
- Antibiotics, oral decongestants, and beta-2 agonists **ARE NOT** indicated.

Mild Croup:

Glucocorticosteroids are recommended for mild croup, Dexamethasone 0.6mg/kg (max dose 12mg) is the first line glucocorticoid therapy for croup. There is no difference in PO versus IM dexamethasone or Prednisolone 2mg/kg/day for 3 days.

Relative contraindications include the child with a known immune deficiency.

Moderate/Severe Croup:

- All patients should get dexamethasone 0.6mg/kg (max dose 12mg) given once orally or intramuscularly if not previously given.
- Administer nebulized epinephrine, (L-epinephrine 1:1000 is as effective as racemic epinephrine) for severe respiratory distress (i.e., marked sternal wall indrawing and agitation) for the temporary relief of symptoms of airway obstruction, repeat racemic epinephrine dose if a poor response to the first treatment or respiratory symptoms recur after an initial good response.
- Nebulized budesonide IS NOT routinely indicated for the treatment of croup. Exceptions include patients with: Persistent vomiting or severe respiratory distress, the appropriate dose concentration of budesonide is 2mg Budesonide may be mixed with epinephrine and administered simultaneously.

Indications for Admission:

Significant respiratory distress persisting four or more hours after treatment with corticosteroids Consider admission if:

- ✓ Lack of timely access to care.
- ✓ Risk of no observation and follow-up.
- ✓ Significant parental anxiety.
- ✓ Multiple emergency department (ED) visits within 24 hours.

Inpatient management:

1. All patients should get dexamethasone if not previously given. Epinephrine should be given
2. Oxygen is indicated for cyanosis, hypoxia, or respiratory distress.
3. Observe for Signs of impending respiratory failure: (a) poor respiratory effort, (b) severe retractions, (c) poor response to epinephrine, (d) decreased level of consciousness, (e) cyanosis/hypoxemia.
4. Consider bacterial tracheitis, epiglottitis, or retropharyngeal abscess in children who appear toxic as they may have an alternative diagnosis and need further workup.

Discharge Criteria:

1. 2hours since last epinephrine.
2. No stridor at rest, tachypnea, intercostal retractions, or other signs of increased work of breathing.
3. Able to talk and feed without difficulty.
4. The patient is able to return to the ED if symptoms return.

Follow-Up:

NOT required for most children with croup.

Bronchiolitis

Diagnosis:

1- It occurs in children under 2 years of age and most commonly in the 1- first year of life, peaking between 3 and 6 months.

2- Its symptoms usually peak between 3 and 5 days, and that cough resolves in 90% of infants within 3 weeks.

3- The child usually has a coryzal prodrome lasting 1 to 3 days, followed by:

- Persistent cough and
- Either tachypnoea or chest recession (or both) and
- Either wheeze or crackles on chest auscultation (or both).

4- The following symptoms are common in babies and children with this disease:

- Fever (in around 30% of cases, usually of less than 39°C)
- Poor feeding (typically after 3 to 5 days of illness).

5- In young infants' apnea may be the sole presentation.

6- Consider a diagnosis of pneumonia if the baby or child has:

- high fever (over 39°C) and/or
- persistently focal crackles.

Clinical Examination:

- Examination should include clinically assess the hydration status of babies and children with bronchiolitis.
- Vital signs are critical.
- Clinical severity assessment is important.

Assessment of Clinical Severity:

	MILD	MODERATE	SEVERE
Behaviour	Normal	Some / intermittent irritability	Increasing irritability and / or lethargy Fatigue
Respiratory rate	Normal–mild tachypnoea	Increased respiratory rate	Marked increase or decrease in respiratory rate
Use of accessory muscles	Nil to mild chest wall retraction	Moderate chest wall retractions Suprasternal retraction Nasal flaring	Marked chest wall retractions Marked suprasternal retraction Marked nasal flaring
Oxygen saturation/ oxygen requirement	Oxygen saturations >92% (in room air)	Oxygen saturations 90–92% (in room air)	Oxygen saturations <90% (in room air) Hypoxemia may not be corrected by oxygen
Apnoeic episodes	None	May have brief apnoea	May have increasingly frequent or prolonged apnoea
Feeding	Normal	May have difficulty with feeding or reduced feeding	Reluctant or unable to feed

Indications for Referral:

Immediately refer babies and children with bronchiolitis for emergency hospital care if they have any of the following:

1. Apnoea (observed or reported).
2. Baby or child looks seriously unwell to a healthcare professional.
3. Severe respiratory distress, for example grunting, marked chest recession, or a respiratory rate of over 70 breaths/minute
4. Central cyanosis.
5. Difficulty with breastfeeding or inadequate oral fluid intake (50% to 75% of usualvolume)
6. Clinical dehydration
7. Persistent oxygen saturation of less than 92%, when breathing air.

Red flags:

1. Chronic lung disease (including bronchopulmonary dysplasia).
2. Haemodynamically significant congenital heart disease.
3. Age in young infants (under 3 months).
4. Premature birth, particularly under 32 weeks.
5. Neuromuscular disorders.
6. Immunodeficiency.

Management of Bronchiolitis:

Investigations:

In most children with bronchiolitis no investigations are required:

Investigations should only be undertaken when there is deterioration or diagnostic uncertainty (eg cardiac murmur with signs of congestive cardiac failure):

- Chest X-ray (CXR) is not routinely indicated and may lead to unnecessary treatment with antibiotics.
- Blood tests (including blood gas, full blood evaluation (FBE), blood cultures) have no role in management.
- Virological testing (nasopharyngeal swab or aspirate) has no role in management of individual patients.

Treatment:

- The main treatment of bronchiolitis is supportive.
  - ➢ This involves ensuring appropriate oxygenation and fluid intake, and minimal handling

Management Approach:

It depends on clinical severity:

	MILD	MODERATE	SEVER
Likelihood of admission	**Sutabile for discharge Consider admission if risk factors present**	**Likely admission, may be able to be discharged after a period of observation**	**Requires admission and consider need for transfer to appropriate children's facility/PICU**
Observations vital signs (respiratory rate, heart rate, oxygen saturation, temperature)	**Adequate assessment in ED prior to discharge (minimum of two recorded measurements of every four hours)**	**1-2 hourly (not continuous)** **Once improving and not requiring oxygen for two hours discontinue oxygen saturation monitoring**	**Hourly with continuous cardiorespiratory (including oximetry) monitoring and close nursing observation**
Hydration /nutrition	**Small frequent feeds**	**If not feeding adequately (<50%over 12hrs), administer NG hydration**	**If not feeding adequately (<50%over 12hrs), or unable to feed administer NG hydration**
Oxygen saturation, oxygen requirements	**Nil requirement**	**If oxygen saturation falls below 90%, administer oxygen to maintain saturation ≥ 90%** **Once improving and not requiring oxygen for 2 hours discontinue oxygen saturation monitoring**	**Administer oxygen to maintain saturation ≥ 90%**
Respiratory support		**Begin with nasal prong oxygen** **High flow nasal cannula (HFNC) to be used only if nasal prong oxygen has failed**	**Consider HFNC or continuous positive airway pressure (CPAP)**

PICU admission:

All severe cases if severity does not improve Consider ICU review/ admission or transfer to local Centre with pediatric ICU capacity if:

- Severity does not improve.
- Persistent Desaturations.
- Significant or recurrent apnoea associated with desaturations.
- Has risk factors

Drugs for management of bronchiolitis:

- Salbutamol inhalation therapy can be used in children with bronchiolitis
- Hypertonic saline in certain situation after consultation of consultant in duty
- Inhaled corticosteroids may be used in recurrent bronchiolitis

Do not use any of the following to treat bronchiolitis in babies or children:

- Antibiotics.
- Adrenaline (nebulised).
- Montelukast.
- Ipratropium bromide.
- Systemic corticosteroids.

Oxygen Therapy:

1- Give oxygen supplementation to babies and children with bronchiolitis if their oxygen saturation is:

   a. persistently less than 90%, for children aged 6 weeks and over.

   b. persistently less than 92%, for babies under 6 weeks or children of any age withunderlying health conditions.

2- Consider continuous positive airway pressure (CPAP) in babies and children with bronchiolitis who have impending respiratory failure.

Upper Airway Suction:

1- Do not routinely perform upper airway suctioning in babies or children with bronchiolitis.
2- Consider upper airway suctioning in babies and children who have respiratory distress or feeding difficulties because of upper airway secretions.
3- Perform upper airway suctioning in babies and children with bronchiolitis presenting with apnoea even if there are no obvious upper airway secretions.

Blood Gas:

1- Do not routinely carry out blood gas testing in babies or children with bronchiolitis.
2- Consider carrying out capillary blood gas testing in babies and children with severe worsening respiratory distress (when supplemental oxygen concentration is greater than 50%) or suspected impending respiratory failure.

Fluid Therapy:

1- Give fluids by nasogastric or orogastric tube in babies and children with bronchiolitis if they cannot take enough fluid by mouth.
2- Give intravenous isotonic fluids to babies and children who do not tolerate nasogastric or orogastric fluids or have impending respiratory failure.

Chest Physiotherapy:

Do not perform chest physiotherapy on babies and children with bronchiolitiswho do not have relevant comorbidities (for example spinal muscular atrophy, severe tracheomalacia).

Discharge Criteria:

1- When deciding on the timing of discharge for babies and children admitted to hospital, make sure that they:
   - Are clinically stable.
   - Are taking adequate oral fluids.
   - Have maintained an oxygen saturation in air at the following levels for 4 hours, including a period of sleep:
     - Over 90%, for children aged 6 weeks.
     - Over 92%, for babies under 6 weeks or children of any age with underlying health conditions.

2- When deciding whether to discharge a baby or child, take into account factors that might affect a carer's ability to look after a baby or child with bronchiolitis, for example:
   - Social circumstances.
   - The skill and confidence of the career in looking after a baby or child with bronchiolitis at home.
   - Confidence in being able to spot red flag symptoms.
   - Distance to healthcare in case of deterioration.

Asthma Exacerbation

Definition:

A flare-up or exacerbation of asthma in children is defined as:

An acute or sub-acute deterioration in symptom control that is sufficient to cause distress or risk to health, to the extent that a visit to a health care provider or treatment with systemic corticosteroids becomes necessary, they are sometimes called 'episodes'

Assessment:

Early symptoms of an exacerbation may include any of the following:

1. An acute or sub-acute increase in wheeze and shortness of breath.
2. An increase in coughing, especially while the child is asleep.
3. Lethargy or reduced exercise tolerance.
4. Impairment of daily activities, including feeding.
5. A poor response to reliever medication.

The signs that should be assessed are:

1. Respiratory rate.
2. Pulse rate.
3. Amount of breathlessness (ability to talk and feed).
4. Ability to speak in full sentences.
5. Use of accessory muscles of respiration.
6. Extent and loudness of wheezing (which becomes less audible with increasingly severe airways obstruction).
7. Level of consciousness and presence of agitation (suggesting hypoxaemia).

Initial Assessment of Severity <5y:

Symptoms	Mild	Severe
Altered consciousness	NO	Agitated, confused, Drowsy
SPO2 on presentation	>95 %	<92 %
Speech	sentences	Words
Pulse rate	< 100 /min	>200/min (0-3y) >160(4-5y)
Central cyanosis	Absent	Likely present
Wheeze intensity	Variable	May be quit chest

Initial Assessment of Severity>5y:

Mild/Moderate	Severe
Talks in phrases, prefers sitting to lying, not agitated Respiratory rate increased <30 breaths/minute Accessory muscles not used Pulse rate 100-120 bpm O2 saturation (on air) >92% PEF >50% predicted or best	Talks in words, sits hunched forward, agitated Respiratory rate increased >30 breaths/minute Accessory muscles in use Pulse rate >120 bpm O2 saturation (on air) <92% PEF ≤50% predicted or best

Risk factors for Asthma related Death:

- Any history of near-fatal asthma requiring intubation and ventilation.
- Hospitalization or emergency care for asthma in last 12 months.
- Not currently using ICS, or poor adherence with ICS.
- Currently using or recently stopped using OCS =Severe.
- Over-use of SABAs, especially if more than 1 canister/month.
- Lack of a written asthma action plan.
- History of psychiatric disease or psychosocial problems.
- Confirmed food allergy in a patient with asthma.

Management:

Oxygen by face mask to achieve and maintain percutaneous oxygen saturation of 94–98%

5 years and younger

- 2-6puffs of salbutamol by spacer, or 2.5 mg of salbutamol by nebulizer, every 20 minutes for the first hour.

For severe exacerbations:

give oral prednisolone (1–2 mg/kg up to a maximum 20 mg for children <2 years old; 30 mg for children 2–5 years)

OR, intravenous methylprednisolone 1 mg/kg 6-hourly on day one.

6 years and older

- For mild to moderate exacerbations, repeated administration of inhaled SABA (up to 4–10 puffs every 20 minutes for the first hour)

Used in all but the mildest exacerbations

1–2 mg/kg/day oral prednisolone for children 6–11 years up to a maximum of 40mg/day) or 200 mg hydrocortisone in divided doses (short course)

In Moderate to Severe Cases

- Ipratropium bromide at a dose of 250ug by nebulization can be mixed with SABA to be repeated every 20 minutes (for 1 hour only).
- Nebulized isotonic magnesium sulfate 150 mg can be added in children ≥2 years old.

Assess the child as regards Symptoms:

- If symptoms still persistent or worsening
- If symptoms recur within 4 hours after improvement

Admit

5 years and younger

- If symptoms improved at 1st hour but recurred, give additional 2–3 puffs SABA per hour
- Admit to hospital if >10 puffs required in 3–4 hours.
- Failure to respond at 1 hour, or earlier deterioration, should prompt urgent admission to hospital and a short-course of oral prednisolone OR, intravenous methylprednisolone 1 mg/kg 6-hourly on day one
- Continue Oxygen by face mask to achieve and maintain percutaneous oxygen saturation of 94–98% (short

6 years and older

- The dose of SABA required varies from 4–10 puffs every 3–4 hours up to 6–10 puffs every 1–2 hours, or more often.
- Continue Oxygen by face mask to achieve and maintain percutaneous oxygen saturation of 94–98%
- Continue or intiate 1–2 mg/kg/day oral prednisolone or 200 mg hydrocortisone in divided doses (short course)

For severe asthma exacerbations in children 2years and above who fail to respond to initial treatment:

give slow IV infusion of magnesium sulfate as a single dose of 50 mg/kg/dose (max. 2gm) over 20-60 minutes in the following setting: Emergency department in hospitals and with close monitoring of the vital data.

If improved

Discharge home with: home management plan Follow up plan

If Not Improving or Deteriorating

Consider PICU ADMISSION

Children can be discharged when:

1. Stable on 3-4 hourly inhaled bronchodilators that can be continued at home.
2. PEFor FEV1should be >75% of best or predicted.
3. PO2>94%

Arrange follow up by primary care service within 2 -7 days

Community Acquired Pneumonia in immunocompetent Patient

Definition of Different Types of Pneumonia:

- ***Community Acquired Pneumonia***: Pneumonia that is acquired outside the hospital ie caused by community acquired infection in a previously healthy child
- ***Hospital Acquired Pneumonia***: Pneumonia that occurs 48 hours or more after hospital admission and not diagnosed at the admission time
- ***Health care associated Pneumonia***: Health care-associated pneumonia community-based patients who have had recent contact with the health care system, such as those who reside in nursing homes or other long-term care facilities or visit dialysis centers and infusion centers.

Criteria of Respiratory Distress in Children With Pneumonia:

1. Tachypnea, RR, breaths/min:
   - Age 0–2 months >60
   - Age 2–12 months > 50
   - Age 1–5 Years >40
   - Age >5 Years >20
   - Dyspnea
2. Retractions.
3. Grunting.
4. Nasal flaring.
5. Apnea.
6. Altered mental status.
7. Pulse oximetry <90% on room air.

Etiology of Pneumonia in Different Age Group:

Table 1. Age-Based Etiologies of Childhood Community-Acquired Pneumonia

Age	*Common etiologies*	*Less common etiologies*
2 to 5 years	Respiratory syncytial virus Human metapneumovirus Parainfluenza viruses Influenza A and B Rhinovirus Adenovirus Enterovirus *S. pneumoniae* *M. pneumoniae* *H. influenzae* (B and nontypable) *C. pneumoniae*	*Staphylococcus aureus* (including methicillin-resistant *S. aureus*) Group A streptococcus
Older than 5 years	*M. pneumoniae* *C. pneumoniae* *S. pneumoniae* Rhinovirus Adenovirus Influenza A and B	*H. influenzae* (B and nontypable) *S. aureus* (including methicillin-resistant *S. aureus*) Group A streptococcus Respiratory syncytial virus Parainfluenza viruses Human metapneumovirus Enterovirus

Clinical Criteria for diagnosis of CAP:

- No single symptom or sign is pathognomonic for pneumonia in children.
- Combination of fever and cough is suggestive of pneumonia
- Other respiratory findings (eg, tachypnea, increased work of breathing) may precede cough.
- Cough may not be a feature initially since the alveoli have few cough receptors.

CAP in neonates:

- Fever and cough may be absent
- tachypnea, and signs of respiratory distress such as grunting, flaring and retractions.
- hypothermia and temperature instability may be observed.
- Irritability or poor feeding or Cyanosis

CAP in Infant and Children:

- Cough is the most common presenting symptom.
- Tachypnea, grunting, Vomiting, poor feeding, and irritability are common.
- CAP due to Atypical organisms, such as Mycoplasma pneumonia are characterized by
- wheeze and other constitutional symptoms, such as headache, malaise, pharyngitis, otalgia, myalgia, pleuritic chest pain, and vague abdominal pain

Indications of admission to hospital?

- Moderate to Severe CAP (Respiratory distress, hypoxemia SpO2 <90%.
- <3–6 months of age with suspected bacterial CAP.
- Children and infants for whom there is concern about careful observation at home or who are unable to comply with therapy or unable to be followed up.
- Not accepting oral feeding or vomiting.
- Children and infants with suspected or documented CAP caused by a pathogen with increased virulence, such as community-associated methicillin-resistant Staphylococcus aureus (CA-MRSA).

Indications for PICU Admission

1. Impending respiratory failure.
2. If the child has sustained tachycardia, inadequate blood pressure, or need for pharmacologic support of blood pressure or perfusion.
3. If the child requires invasive ventilation via a nonpermanent artificial airway
4. If the pulse oximetry measurement is <92% on inspired oxygen of ≥0.50
5. If the child has altered mental status, whether due to hypercarbia or hypoxemia as a result of pneumonia.
6. If the child acutely requires use of noninvasive positive pressure ventilation (eg, continuous positive airway pressure or bilevel positive airway pressure).

Preliminary Pediatric Pneumonia Workup:

Pulse Oximetry:

PULSE OXIMETRY INTERPRETATION	
SpO_2 READING (%)	INTERPRETATION
95 – 100	Normal
91 – 94	Mild Hypoxemia
86 – 90	Moderate Hypoxemia
< 85	Severe Hypoxemia

A-Lab investigations:

1. CBC (WBC count <15,000/micro L suggests a nonbacterial etiology, except in the severely ill patient, who also may be neutropenic and have a predominance of immature cells).

2. CRP serial measurements for follow up.

- it cannot be used as the sole determinant to distinguish between viral and bacterial causes of CAP.
- cannot be used to confirm diagnosis.
- Decisions about diagnosis should not be based on inflammatory markers alone.
- May be useful in assessing the resolution of an inflammatory process.

3. Blood Culture:

- Blood cultures are positive in less than 5% of patients with pneumococcal pneumonia and even less with Staphylococcus.
- Repeat blood cultures in children with bacteremia caused by S. aureus, regardless of clinical status.

4. Examination of Sputum should be considered for patients who do not respond to empirical antibiotic therapy if the child can produce sputum

B-Radiological Investigation:

1. Chest X Ray

- **Indications for chest x ray:**
  - Hospitalization.
  - prolonged and unresponsive.
  - recurrent pneumonia.
  - Severe disease.
  - Expected complications.

NB:

- **Radiographic findings cannot reliably distinguish between bacterial, atypical bacterial, and viral etiologies of pneumonia**
- **No need to repeat x ray except if no response after 48 h or if sudden deterioration.**

- **When to repeat chest x ray after discharge:**

Repeated chest radiographs 4–6 weeks after discharge should be obtained in patients:

- Recurrent pneumonia involving the same lobe
- patients with lobar collapse on initial chest radiography with suspicion of an anatomic anomaly, chest mass, or foreign body aspiration.

2. CT Scan

- **Indications for CT Chest**

Not indicated in any child with CAP except:

- Failed Antibiotic treatment.
- Complications, such as pleural effusions.
- Treatment decisions surgical debridement of organized empyema or loculated effusions).

Antibiotic protocol for hospitalized child with CAP:

1. **Ampicillin- Salbactam and Third-generation parenteral cephalosporin's**
2. Add macrolide (oral), for whom M. pneumoniae are significant considerations as school aged children.
3. **Vancomycin or clindamycin** should be provided in addition to β-lactam therapy if clinical, laboratory, or imaging characteristics are consistent with infection caused by CA-MRSA

Appropriate Duration of Antimicrobial Therapy for CAP:

- Treatment courses of 10 days.
- Infections caused by certain pathogens, notably CA-MRSA, may require longer treatment.

Parenteral antibiotics can be shifted to oral therapy:

- As early as 2-3 d after the start of parenteral therapy if:
- Clinical Improvement and starting reduction in peripheral leukocyte counts and/or CRP or other acute phase reactants and absence of bacteremia.

Criteria for discharge a child with CAP:

- Clinical improvement, level of activity, appetite, and decreased fever for at least 12–24 h.
- Pulse oximetry > 90% in room air for at least 12–24 h.
- Stable and/or baseline mental status.
- Tolerate their home anti-infective regimen

How to follow up the child with CAP for the expected response to therapy?

✓ Children on adequate therapy should start demonstrating clinical and laboratory improvement within 48–72 hrs.

Management of non-responding pneumonia in children (EPCP) committee 2020

1-No improvement or deterioration within 48-72 h of admission and appropriate antibiotic intake
-persistent high fever and or persistent tachypnea or RD
-persistent elevated of CRP or other inflammatory marker
-Radiological deterioration
-systemic or focal symptoms or signs including: **1**. clinically defined "toxicity" based on clinical judgment or change in mental status **2**. sever chest pain reducing the inspiratory effort **3**. inability to maintain oral intake and hydration
2- or significant worsening at any time after initiation of therapy

↓

Admit if he was an outpatient – reassess – consult pediatric pulmonologist

↓

Complicated CAP

- Necrotizing pneumonia
- Empyema
- Pneumothorax
- Organ failure as heart failure
- sepsis

CAP with resistant organism

eg: MRSA or Klebsiella

CAP with underlying comorbid condition

- Foreign body
- Immunodeficiency
- Bronchiectasis and cystic fibrosis
- Underlying cardiac disease

Investigations

- CT chest or chest ultrasound
- Microbiological studies (sputum, blood, nasopharyngeal swab, gastric aspirate)
- Bronchoscopy and BAL
- Immune studies
- Echocardiography
- Sepsis work up (lactate, LDH, ABG, repeat acute phase reactants)

Treatment

- Empyema: intercostal drainage +/-intra-pleural fibrinolytic instillation
- Resistant organism: adjust antibiotics according to culture
- Necrotizing pneumonia: add clindamycin or linezolid
- Immunodeficiency: consult immunologist
- Heart failure: anti-failure medications
- Sepsis: more broad-spectrum antibiotics and possible PICU

Prophylaxis of Respiratory Syncytial Virus (RSV)

RSV accounts for approximately 50% of all cases of pneumonia and up to 90% of the reported cases of bronchiolitis in infancy.

RSV infection frequently progresses to the lower respiratory tract, where it can cause wheezing, cough, and dyspnea in infants, these symptoms usually appear 1 to 3 days after the onset of rhinorrhea.

High Risk population

- Higher-Risk Populations Include Preterm Infants and Children <2 Years Old With BPD or HSCHD.
- Hospitalization rates are higher in high-risk groups, including premature infants and those with underlying cardiac or pulmonary diseases.

Prophylaxis: Palivizumab

Passive prophylaxis with palivizumab decreases the frequency of hospitalization for RSV in high-risk infants. It is cost-effective only for infants at high risk of hospitalization.

1-Children born at 35 weeks of gestation or less and less than 6 months of age at the onset of the RSV season.

2- Children less than 2 years of age and requiring treatment for bronchopulmonary dysplasia within the last 6 months.

3- Children less than 2 years of age and with hemodynamically significant congenital heart disease.

NB:

- Palivizumab should be administered up to a maximum of 5 monthly doses (15 mg/kg per dose administered intramuscularly once every 30 days) during the RSV season to infants who qualify for prophylaxis in the first year of life.
- A child with a history of a severe allergic reaction following a dose of Palivizumab should not receive additional doses.
- Palivizumab is not approved or recommended for the treatment of RSV disease
- Palivizumab does not interfere with routine childhood immunizations.

REFERENCES:

1. Piedimonte G, Perez MK. Pediatr Rev. 2014;35(12):519-530.
2. Wat D. Eur J Intern Med. 2004;15(2):79-88.
3. Domachowske JB, Rosenberg HF. Clin Microbiol Rev. 1999;12(2):298-309.
4. Karron R. Plotkin's Vaccines. 7th ed. Elsevier; 2018:943-949.
5. Erdoğan S, et al. Turk J Anaesthesiol Reanim. 2019;47(4):348-351. . Piedimonte G, Perez MK. Pediatr Rev. 2014;35(12):519-530.
6. Wat D. Eur J Intern Med. 2004;15(2):79-88. Domachowske JB, Rosenberg HF. Clin Microbiol Rev. 1999;12(2):298-309.
7. Respiratory syncytial virus infection (RSV): symptoms and care. Centers for Disease Control and Prevention. Updated June 26, 2018. Accessed December 21, 2021. (https://www.cdc.gov/rsv/about/symptoms.html).
8. Piedimonte G, et al. Pediatr Rev. 2014;35(12):519-530.
9. Sommer C, et al. Open Microbiol J. 2011;5(Suppl 2-M4):144-154
10. World Health Organization. Preterm birth. Published February 19, 2018. (https://www.who.int/news-room/fact-sheets/detail/preterm-birth).
11. Jensen EA, et al. Clinical and Molecular Teratology. 2014;100(3):145-157
12. Rezaee F, et al. Curr Opin Virol. 2017;24:70-78.

Appendix

Coughing Score:

This is a quantitative scoring system of cough used to assess the severity of cough and efficacy of treatment. Daytime and nighttime scoring is done, however it may be difficult to discriminate between grades (Table)

Score	Daytime Cough Symptom Score	Nighttime Cough Symptom Score
0	No cough	No cough
1	Occasional, transient cough	Transient cough when falling sleep or occasional cough during the night
2	Frequent cough, slightly influencing daytime activities	Cough slightly influencing sleep
3	Frequent cough, significantly influencing daytime activities	Cough significantly influencing sleep

Source: Chung KF (2006), Irwin RS (2006)

Cough Red Flags:

That prompt referral includes:

- ✓ Significant systemic illness
- ✓ Change in mental status
- ✓ Dyspnea (breathlessness)
- ✓ Pleuritic chest pain
- ✓ Prolonged or high fever
- ✓ Abnormal respiratory exam (e.g., wheezing, crackles, stridor)
- ✓ Increased work of breathing (e.g., respiratory rate >20 breaths/minute, using accessory muscles to breathe, unable to speak normally)
- ✓ Cyanosis (e.g., bluish or purple discoloration of lips/mouth, or fingers/hands, which may feel cold to the touch)
- ✓ Hemoptysis
- ✓ Suspicion of inhaled foreign body
- ✓ Dysphagia

Source: Glashan E, Mahmoud SH,(2019)

Ten Warning Signs of Primary Immunodeficiency:

Two or more of these warning signs should alert the clinician to the possibility of primary immunodeficiency and merit further assessment

1- Four or more new ear infections within 1 year
2- Two or more serious sinus infections within 1 year
3- Two or more month on antibiotics with little effect
4- Two or more pneumonia within 1 year
5- Failure of an infant to gain weight or grow normally
6- Recurrent, deep skin or organ abscesses
7- Persistent thrush in mouth or fungal infection on skin
8- Need for intravenous antibiotics to clear infections
9- Two or more deep-seated infections, including septicemia
10- A family history of primary immunodeficiency

Source: Modell v, et al .2 available at: http://downloads .info4pi .org / pdfs /Physician-Algorithm—2-pdf

Pediatric Pulmonology

"We offer comprehensive reviews of selected topics and comprehensive advice about management approaches based on the highest level of evidence available in each case. Our goal is to provide an authoritative practical medical resource for pediatricians.
We hope that such an approach will encourage clinicians to apply available evidence to their practice and also track compliance with desired practices."

El Forsan Towers 1, El-Nasr Rd,
Masaken Al Mohandesin, Nasr City, Cairo Governorate

15344

www.gah.gov.eg

Scan me