NATIONAL CLINICAL GUIDELINES

THE DIAGNOSIS & MANAGEMENT OF ASTHMA IN CHILDREN

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المبادئ الإرشادية السريرية لدولة قطر
NATIONAL CLINICAL GUIDELINES FOR QATAR

وزارة الصحـــــة العامـــــة
Ministry of Public Health
State of Qatar • دولـــة قطـــر

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Version History

Version	Status	Date	Editor	Description
1.0	Initial Version	14th December 2016	Guidelines Team	Published version.
2.0	Updated Version	28th July 2019	Guidelines Team	Updated Published Version.

Citation

Suggested citation style:

Ministry of Public Health Qatar. National Clinical Guideline: The Diagnosis and Management of Asthma in Children (2019).

Abbreviations

The abbreviations used in this guideline are as follows:

FE_{NO}	Fractional Exhaled Nitric Oxide
FEV1	Forced Expiratory Volume in 1 second
FVC	Forced Vital Capacity
LABA	Long-acting beta$_2$-agonist
$PaC0_2$	Partial pressure of carbon dioxide
$Pa0_2$	Partial pressure of oxygen
PEFR	Peak Expiratory Flow Rate
PICU	Paediatric Intensive Care Unit
pMDI	Pressurised Metered Dose Inhaler
SABA	Short-acting beta$_2$-agonist
$Sp0_2$	Oxygen saturation
URTI	Upper Respiratory Tract Infection
LAMA	Long Acting Muscarinic Antagonist
IL-5	Interleukin 5
SLIT	Sublingual Immunotherapy
HDM	House Dust Mites

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1 Information About This Guideline

1.1 Objective and Purpose of the Guideline

The purpose of this guideline is to define the appropriate diagnosis and management of asthma in children. The principal objective is to reduce unwarranted variations in the care of children with asthma and reduce the incidence of complications arising from suboptimal management. The objective of this guideline is also to reduce inappropriate prescribing and/or referral of patients presenting to provider organisations in Qatar, whilst improving the recognition and management of those at risk of complications. It is intended that the guideline will be used by healthcare professionals in all settings.

1.2 Scope of the Guideline

This guideline covers the following aspects of care:

- Assessment and management of:
  - Acute exacerbations of asthma in children (up to 18 years of age).
  - Chronic asthma in children, in both primary and secondary care settings.
- Transitions of care from paediatric to adult services.
- Indications for referral to emergency and specialist care.

1.3 Editorial Approach

This guideline document has been developed and issued by the Ministry of Public Health of Qatar (MOPH), through a process which aligns with international best practice in guideline development and localisation. The guideline will be reviewed on a regular basis and updated to incorporate comments and feedback from stakeholders across Qatar.

The editorial methodology, used to develop this guideline, has involved the following critical steps:

- Extensive literature search for well-reputed published evidence relating to the topic.
- Critical appraisal of the literature.
- Development of a draft summary guideline.
- Review of the summary guideline with a Guideline Development Group, comprised of practising healthcare professionals, subject matter experts and patient representatives, from across Qatar.
- Independent review of the guideline by the National Clinical Guidelines & Pathways Committee, appointed by the MOPH, from amongst stakeholder organisations across Qatar.

Whilst the MOPH has sponsored the development of the guideline, the MOPH has not influenced the specific recommendations made within it.

1.4 Sources of Evidence

The professional literature has been systematically queried using specially developed, customised, and tested search strings. Search strategies are developed to allow efficient yet comprehensive analysis of relevant publications for a given topic and to maximise retrieval of articles with certain desired characteristics pertinent to a guideline.

For each guideline, all retrieved publications have been individually reviewed by a member of the Editorial Team and assessed in terms of quality, utility, and relevance. Preference is given to publications that:

1. Are designed with rigorous scientific methodology.
2. Are published in higher-quality journals.
3. Address an aspect of specific importance to the guideline in question.

Further information about the literature search and appraisal process is included in the appendix.

1.5 Evidence Grading and Recommendations

Recommendations made within this guideline are supported by evidence from the medical literature and where possible the most authoritative sources have been used in the development of this guideline. In order to provide insight into the evidence basis for each recommendation, the following evidence hierarchy has been used to grade the level of authoritativeness of the evidence used, where recommendations have been made within this guideline.

Where the recommendations of international guidelines have been adopted, the evidence grading is assigned to the underlying evidence used by the international guideline. Where more than one source has been cited, the evidence grading relates to the highest level of evidence cited:

- **Level 1 (L1):**
  - Meta-analyses.
  - Randomised controlled trials with meta-analysis.
  - Randomised controlled trials.
  - Systematic reviews.

- **Level 2 (L2):**
  - Observational studies, examples include:
    - Cohort studies with statistical adjustment for potential confounders.
    - Cohort studies without adjustment.
    - Case series with historical or literature controls.
    - Uncontrolled case series.
  - Statements in published articles or textbooks.

- **Level 3 (L3):**
  - Expert opinion.
  - Unpublished data, examples include:
    - Large database analyses.
    - Written protocols or outcomes reports from large practices.

In order to give additional insight into the reasoning underlying certain recommendations and the strength of recommendation, the following recommendation grading has been used, where recommendations are made:

- **Recommendation Grade A (RGA):** Evidence demonstrates at least moderate certainty of a net benefit from the recommendation.
- **Recommendation Grade B (RGB):** Evidence is insufficient, conflicting, or poor and demonstrates an incomplete assessment of net benefit vs harm; additional research is recommended.
- **Recommendation Grade C (RGC):** Evidence demonstrates potential harm that outweighs benefit; additional research is recommended.
- **Recommendation of the GDG (R-GDG):** Recommended best practice on the basis of the clinical experience of the Guideline Development Group members.

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1.6 Guideline Development Group Members

The following table lists members of the Guideline Development Group (GDG) nominated by their respective organisations and the Clinical Governance Group. The GDG members have reviewed and provided feedback on the draft guideline relating to the topic. Each member has completed a declaration of conflicts of interest, which has been reviewed and retained by the MOPH.

Guideline Development Group members		
Name	**Title**	**Organisation**
Dr Mohannad Abdulkader	Consultant Paediatrician	Dr Mohannad Polyclinic
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Dr Mehdi Al Adeli	Senior Consultant Allergy/Immunology	Hamad Medical Corp
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Dr Abdulmuneim Al Obaidi	Consultant Paediatrician	Ministry of Interior Clinics
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Dr Amani Al Yafei	Family Medicine Specialist	Primary Health Care Corp
Dr Mohammed Anas Barakat	Consultant Paediatrician	Al Ahli Hospital
Dr Ihab Koura	Consultant Paediatrician	Al Ahli Hospital
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Dr Radwa Sameh Saeed	General Practitioner - Paediatric	Doha Clinic
Dr Amjad Tuffaha	Senior Consultant Paediatric Pulmonologist	Sidra Medicine
Dr Bashier Youssef	Senior Consultant Paediatric Emergency	Hamad Medical Corp

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1.7 National Clinical Guidelines & Pathways Committee Members

The following table lists members of the National Clinical Guidelines & Pathways Committee (NCGPC), appointed by the MOPH. The NCGPC members have reviewed and provided their feedback and approval of the guideline document. Each member has completed a declaration of conflicts of interest, which has been reviewed and retained by the MOPH.

National Clinical Guidelines & Pathways Committee (NCGPC) Members		
Name	**Title**	**Organisation**
Ms Huda Amer Al-Katheeri	Chair of the NCGPC, Director of Strategic Planning & Performance Department	Ministry of Public Health
Shk Dr Mohammed Hamad J. Al Thani	Co-Chair of the NCGPC, Director of Public Health	Ministry of Public Health
Prof Anthony Akobeng	Chair Clinical Practice Guidelines Committee	Sidra Medicine
Dr Maryam Ibrahim Al-Heidous	Registration coordinator, QCHP	Ministry of Public Health
Dr Alshaymaa Mohammed A. M. Al-Motawa	Consultant Family Medicine	Qatar Petroleum
Dr Abi Khalil Charbel	Associate Professor of Medicine Consultant Cardiology	Weill Cornell Medicine-Qatar
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Dr Mohamed Elrishi	Consultant Endocrinology and Internal Medicine	Al Ahli Hospital
Dr Dahlia Mustafa Hassan	Consultant Family Medicine	Primary Health Care Corp
Dr Ghassan Youseph Hommos	Consultant Endocrinology	Al Emadi Hospital
Dr Chris Kenny	Executive Director Clinical and Service Development, Office of the Chief Medical Officer	Hamad Medical Corporation
Dr Egon Toft	VP and Dean of College of Medicine	College of Medicine, Qatar University

1.8 Responsibilities of Healthcare Professionals

This guideline has been issued by the MOPH to define how care should be provided in Qatar. It is based upon a comprehensive assessment of the evidence as well as its applicability to the national context of Qatar. Healthcare professionals are expected to take this guidance into account when exercising their clinical judgement in the care of patients presenting to them.

The guidance does not override individual professional responsibility to take decisions which are appropriate to the circumstances of the patient concerned. Such decisions should be made in consultation with the patient, their guardians, or carers and should consider the individual risks and benefits of any intervention that is contemplated in the patient's care.

2 Asthma in Children Pathway

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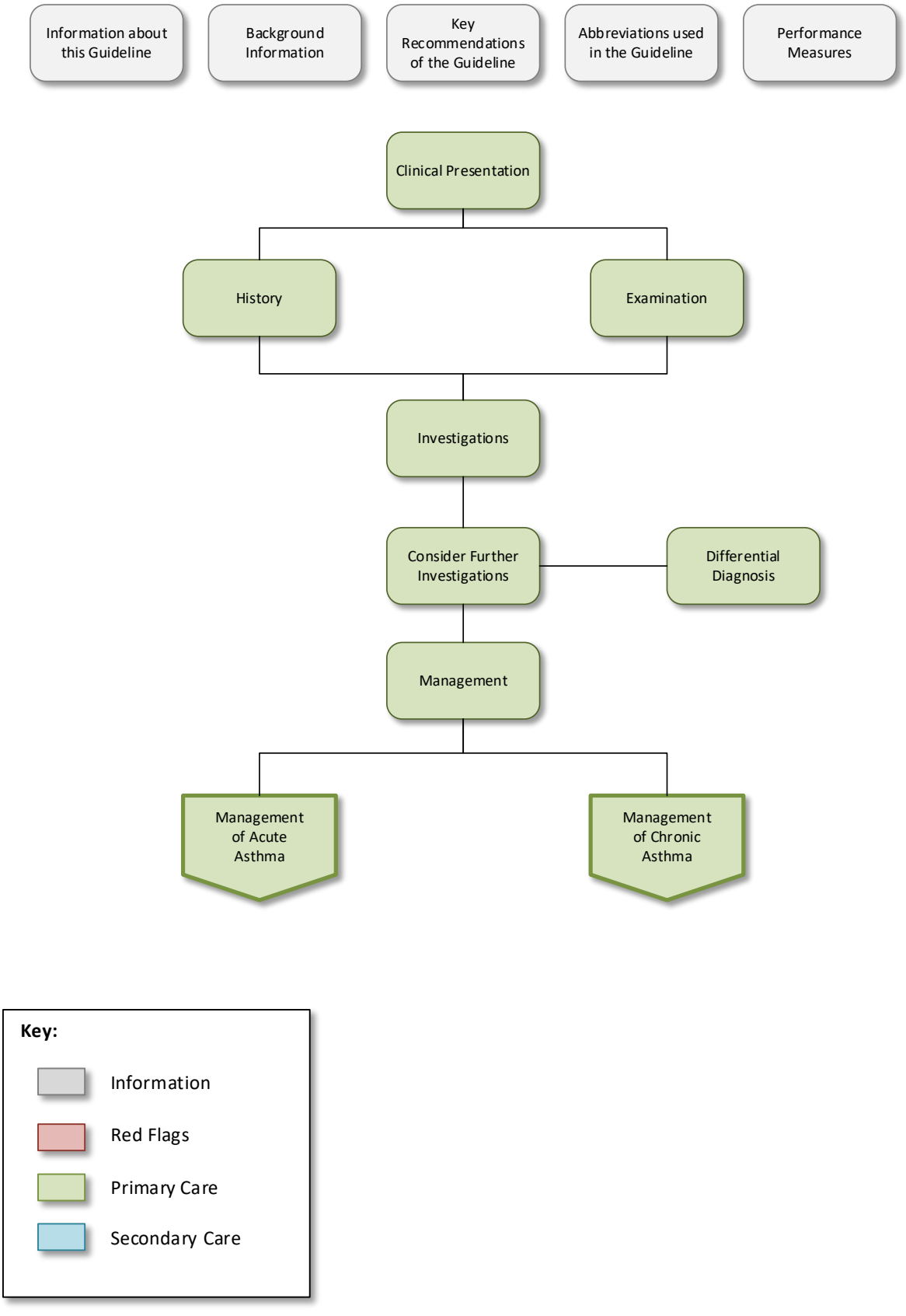

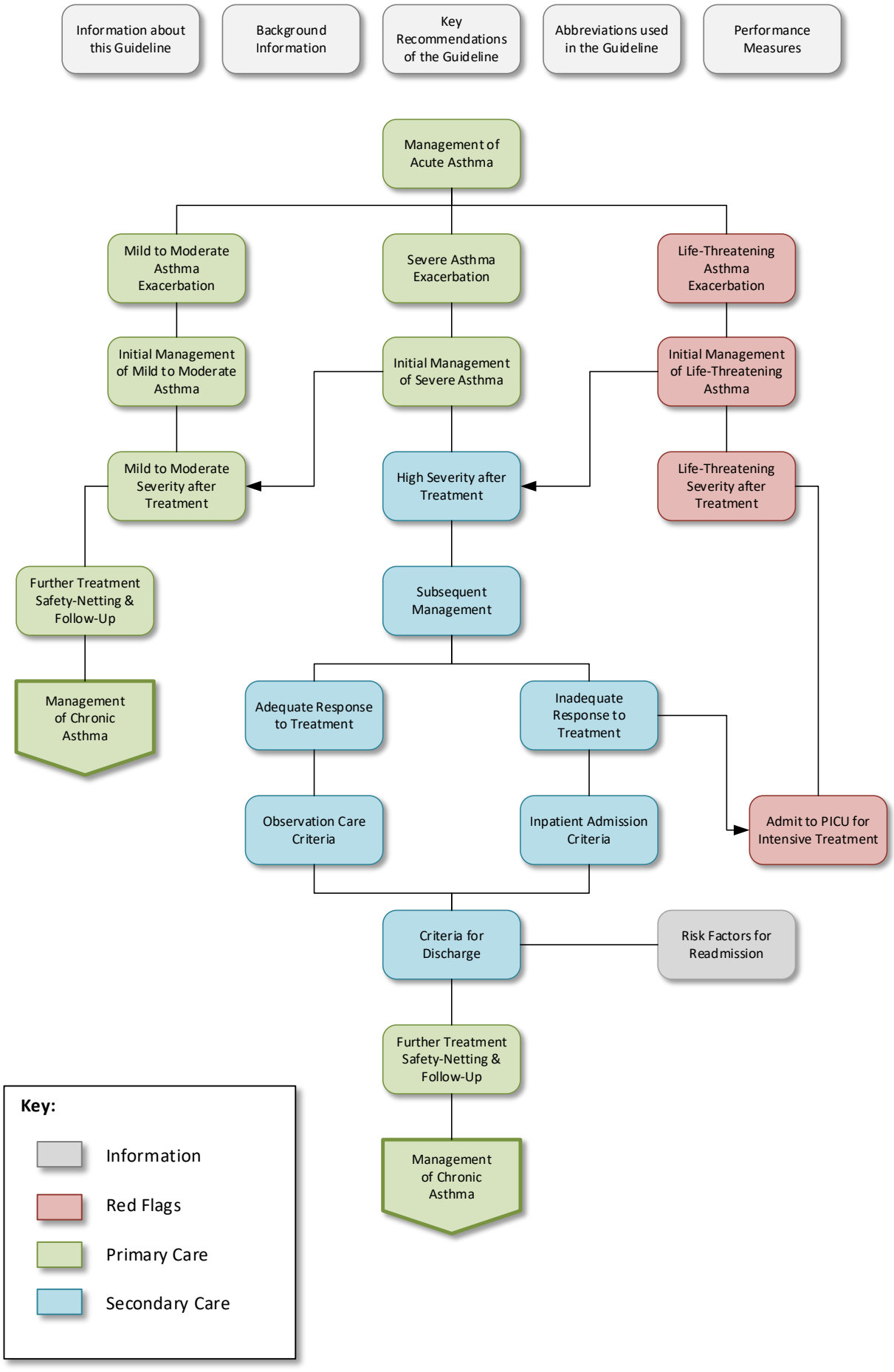
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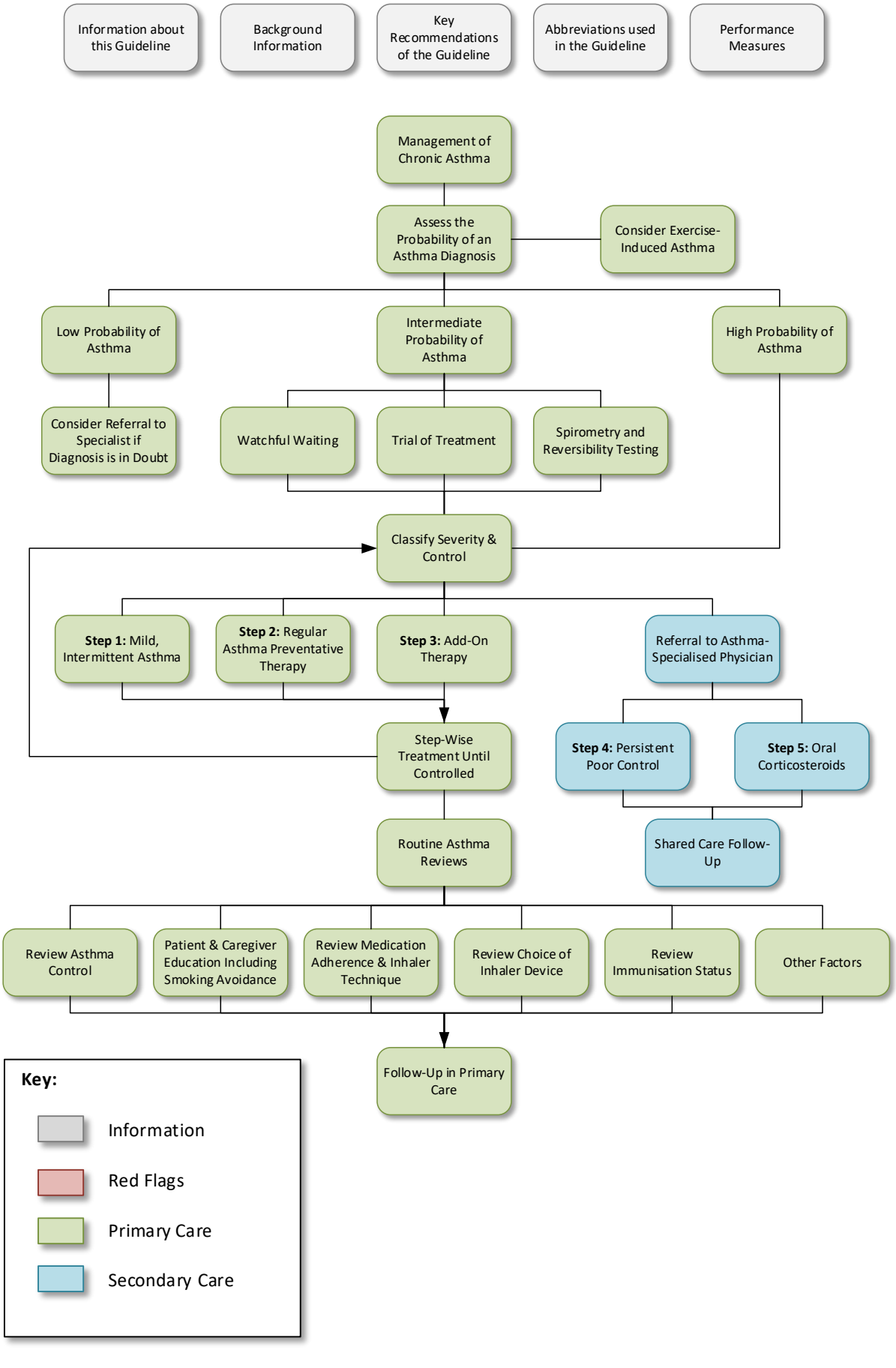
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Key:
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Primary Care
Secondary Care

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3 Key Recommendations of the Guideline

The key recommendations of this guideline are as follows:

Investigations and Diagnosis (*Sections 8 & 9*):

- SpO_2 monitors should be available for use by all health professionals assessing acute asthma in a primary care setting[1][**L2, RGA**].
- PEFR variability should not be used as the sole basis for the diagnosis of asthma[1] [**L2, RGA**].
- PEFR should only be used for monitoring control of asthma[1][**L2, RGB**].
- Reserve spirometry for those patients who are classified as having severe asthma; who have a poor response to treatment; or where there is diagnostic uncertainty[1]**[L2, RGA**].
- Reserve chest radiographs for children with severe disease or clinical clues suggesting other conditions[1][**L2, RGA**].

Management of Acute Exacerbations of Asthma (*Section 10*):

- Except for mild exacerbations, early referral to a **Paediatric Emergency Centre** is strongly recommended as asthma is a preventable cause of death in children [**R-GDG**].
- Initial treatment of the patient should be started with high flow oxygen and nebulised $beta_2$-agonists, whilst awaiting ambulance transfer. Start systemic corticosteroids, if available[1–4][**L1, RGA**].
- Patients should ideally be managed on an outpatient basis or in an observation care setting. However if admission is indicated the optimal length of stay for admission is 1 day[5][**L3**].

Discharge Following Inpatient Admission (*Section 10.4*):

- When discharging a patient following an inpatient admission ensure a written asthma action plan is provided to the patient[1–4,6][**L2, RGA**].
- Provide discharge summary to primary care physician with plan for follow up in primary care [**R-GDG**].
- All patients should be reviewed by their primary care physician within one week of an acute exacerbation of asthma[1][**L2, RGA**].

Management of Chronic Asthma (*Section 11*):

- Consider referral to an asthma-specialised paediatrician for the diagnosis and management of asthma in children aged under 2 years. A diagnosis of asthma in this age group should be questioned if management is ineffective [**R-GDG**].
- Therapies such as omalizumab, ciclosporin or methotrexate should only be used in a suitably experience specialist centre in a 3 months trial when other treatments have failed[7].

Follow-Up (*Section 11.7*):

- All patients should be reviewed by their primary care physician on at least an annual basis to review overall asthma control if asthma is stable[1][L2, **RGA**].
- All asthmatics should be encouraged to receive the influenza vaccine[1–4][**L2, RGA**].
- Advise parents or carers of children with asthma about the danger of passive smoking. Offer parents or carers support to stop smoking [**R-GDG**].

4 Background Information

4.1 Definition

Asthma is defined as a chronic and recurrent, completely or partially reversible airway obstruction; associated with airway inflammation and increased responsiveness of the airways, to a variety of stimuli; in the absence of an alternative explanation[1,8].

4.2 Prevalence

A 2006 observational study by Janahi, Bener and Bush[9], suggests the prevalence rate of asthma may be as high as 19.8% amongst children of Qatari nationals, aged between 6-14 years, in Qatar.

4.3 Aetiology

Asthma comprises a range of heterogeneous phenotypes that differ in presentation, aetiology and pathophysiology. The fundamental causes of asthma however are not completely understood. The risk factors for each recognized phenotype of asthma include genetic, environmental and host factors. Although a family history of asthma is common, it is neither sufficient nor necessary for the development of asthma[8].

The substantial increases in the incidence of asthma over the past few decades and the geographic variation in both base prevalence rates and the magnitude of the increases support the thesis that environmental changes play a large role in the current asthma epidemic. Furthermore, environmental triggers may affect asthma differently at different times of a person's life, and the relevant risk factors may change over time[8].

An acute asthma exacerbation is typically triggered by an acute viral upper respiratory tract infection (URTI) leading to worsening wheeze despite regular doses of inhaled bronchodilators[1].

4.4 Prognosis

In general, the earlier the onset of asthma, the better the prognosis. Most children who present under the age 2 years become asymptomatic by mid-childhood (age 6-11 years)[1,10]. However, early-onset asthma in atopic children may be associated with a worse prognosis[1,10]. Male children are more likely to grow out of asthma in the transition to adulthood[1].

4.5 Complications

Complications of asthma in children, include[1]:

- Death – asthma is a recognised and preventable, cause of death in children in Qatar
- Respiratory complications:
    - Status asthmaticus – acute exacerbation of asthma which remains unresponsive to initial treatment with nebulised bronchodilators
    - Respiratory failure.

    - Collapsed lobe or lung.
    - Pneumothorax.
    - Pneumonia.
- Growth and pubertal delay in children may be due to:
    - A direct result of chronic disease;
    - Secondary to the chronic use of high-dose inhaled corticosteroids:
        - >800 micrograms budesonide from a metered-dose inhaler or
        - >400 micrograms budesonide or fluticasone propionate from a dry-powder inhaler[1];
        - Repeated short courses of systemic corticosteroids[1].
        - The growth-suppressive effects of repeated short courses of systemic corticosteroids may however be relatively short-lived.
        - Inhaled corticosteroids remain the mainstay of treatment[1,11].
- Impaired quality of life may result from suboptimal control of asthma, this may include[1,10–12]:
- Fatigue.
- Underperformance and time off from school.
- Psychological problems, including stress, anxiety, and depression – children may experience social exclusion because they cannot participate fully in activities and sports.
- Impaired family dynamics, resulting from a chronically ill child[1,10,12].

4.6 Risk Factors for Developing Asthma

Risk factors for developing asthma, include[1,8]:

- Family history of atopic disease, especially in first-degree relatives:
    - Asthma.
    - Eczema.
    - Allergic rhinitis.
    - Allergic conjunctivitis.
- Co-existence of atopic disease in the patient:
    - Eczema.
    - Allergic rhinitis.
    - Allergic conjunctivitis.
    - Food allergy.
- Bronchiolitis in infancy.
- Parental smoking, including perinatal exposure to tobacco smoke.
- Low birth weight – associated with intrauterine growth retardation.
- Prematurity, especially in extreme preterm infants who required ventilatory support, with consequent chronic lung disease of prematurity.

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5 Presentation

Asthma in children typically causes recurrent respiratory symptoms of[1–3,13–17]:

- Wheeze.
- Cough.
- Difficulty breathing.
- Chest tightness.

The two main presentations of asthma in children are:

- An acute exacerbation of asthma.
- Chronic asthma.

5.1 Presentation of an Acute Exacerbation of Asthma

An acute exacerbation of asthma, may present with the following features[1–4,13–16]:

- Gradual onset over hours, of cough, shortness of breath and wheeze.
- Increased respiratory effort and decreased exercise tolerance.

The following features increase the risk of children having near-fatal or fatal acute asthma attacks[1–4,18]:

- Previous episodes of near-fatal asthma including the need for intravenous treatment or Paediatric Intensive Care Unit (PICU) admission.
- Poorly controlled asthma despite Step 4 management (see *Section 11.6.4*).
- Daily use of a short-acting beta$_2$-agonist.
- 'Brittle' asthma, i.e. severe and difficult to control asthma despite maximal medical therapy
- Non-attendance at out-patient or primary care appointments.
- Poor compliance with treatment or monitoring of asthma.
- Adverse psycho-social factors e.g. stress, household violence, poor socioeconomic status and segregated living circumstances.

5.2 Presentation of Chronic Asthma

Typical patterns[1–4,6,13–16,19]:

- Intermittent attacks superimposed on a baseline of good control.
- Chronic symptoms punctuated by intermittent worsening.
- Morning 'dipping', characterised by:
  - Worsening of symptoms and decreased peak flow in the early morning.
  - Improvement as the day progresses.
- Prominent nocturnal cough.
- Exercise–associated respiratory symptoms.

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6 History

History taking should be directed to establishing the probability of a diagnosis of asthma and classification of the severity of asthma, according to the pattern of episodic symptoms that the patient reports.

The cardinal features of asthma to elicit in the history, include[1–4,6,8,13–16,18,19]:

- Reported wheeze.
- Response to bronchodilators (see *Section 8*).
- Recurrence of symptoms.
- Chronicity of symptoms.
- Severity of illness.
- Degree of symptom control, if treatment has been initiated.

Additional points in the history to note, include[1–4,6,8,12–16,18,19]:

- Cough.
- Difficulty breathing.
- Chest tightness.
- Atopy, e.g. eczema, rhinitis.
- Family history of asthma and/or atopy.
- Limitation of exercise and physical activities.
- Sleep and sleeping conditions.
- Seasonal or diurnal variation.
- Adverse psycho-social factors including:
    - Stress.
    - Household violence.
    - Poor socioeconomic status.
    - Segregated living circumstances.
- Environmental risk factors, including:
    - Smoking (active or passive).
    - Pets and contact with farm animals.
    - Carpeting.
    - Home environment – proximity to construction, use of incense, water damage or damp.
    - Pesticide and paint exposure.

Episodes of wheeze, cough, and difficulty breathing are associated with viral upper respiratory infections and are common, especially in very young children, however in non-asthmatic cases, symptoms will seldom persist

A definite diagnosis of asthma can be difficult to obtain in young children, therefore[1,6,8]:

- Alternative diagnoses should be carefully considered.
- Regular assessment should be carried out.
- The diagnosis should be questioned if management is ineffective.

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7 Examination

Examination in a patient presenting with an acute exacerbation of asthma should be directed towards establishing the severity of the exacerbation, according to the degree of respiratory distress that is evident and excluding other possible causes of acute respiratory distress[1–4,6,13–16].

The key point to a successful diagnosis, is a structured clinical assessment where the physician uses a combination of symptoms approach rather than isolating symptoms individually, and by evaluating the episodic nature of the detected symptoms and the evidence and variability of airflow obstruction[3,20–23].

In all patients the following points in the examination should be reviewed[1–4,6]:

- Presence of cyanosis.
- Consciousness level.
- Respiratory rate, degree of breathlessness.
- Accessory muscle usage.
- Pulse rate.
- Presence of wheeze (confirmed on auscultation):
    - Inspiratory or expiratory wheeze.
    - A ‘silent chest’ may be indicative of a life-threatening exacerbation.

Examination of a patient presenting with chronic asthma, should focus on[1,3,6]:

- Establishing the presence of the classical end expiratory wheeze. If the patient is asymptomatic at the time of the presentation, then the examination maybe unremarkable.
- Signs of atopic disease e.g. eczema, allergic rhinitis, allergic conjunctivitis.
- Signs of comorbid conditions e.g. gastro-oesophageal reflux, obesity, chronic rhinosinusitis.
- Signs of poorly-controlled chronic disease, e.g.:
    - Chest deformity e.g. ‘barrel chest’.
    - Harrison’s sulci.
- Exclusion of other differential diagnoses.

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8 Investigations

8.1 Principal Investigations

Investigation of the patient with asthma, may include the following:

Oxygen saturation (SpO_2):

- Accurate measurements of SpO_2 are essential for assessing all children with acute wheeze[1,13]. [**L1, RGA**].
- SpO_2 monitors should be available for use by all health professionals assessing acute asthma in a primary care setting[1,13][**L2, RGA**].

Peak Expiratory Flow Rate (PEFR):

- PEFR measurements can be used in children who are able to use the device (typically aged over 5 years old)[1,13][**L2, RGA**].
- The best of three PEFR measurements can be useful in assessing the response to treatment[1,13][**L2, RGB**].
- PEFR variability should not be used as the sole basis for the diagnosis of asthma[1][**L2, RGA**].
- PEFR should only be used for monitoring control of asthma[1,13][**L2, RGB**].

Spirometry[1,3,24]:

- Can be used in children aged over 5 years[**L2, RGA**].
- Should be performed by well-trained and experienced operators who are qualified to provide the test in relevant age groups.
- Used to diagnose and manage asthma in cases of intermediate probability or high severity of chronic asthma, through testing for:
    - Presence and severity of airway obstruction (use lower limit of normal)[**L1, RGA**].
    - Reversibility of airway obstruction with bronchodilators[**L2, RGA**]:
        - Increased in FEV1 of >12% post bronchodilator is regarded as diagnostic of asthma[**L1, RGA**].
        - A normal spirometry in asymptomatic patients cannot exclude asthma.

NB: Testing lung function in children under age 5 years is difficult:

- Offer a trial of treatment and review[1][**L1, RGA**].
- If treatment is unsuccessful, consider an alternative diagnosis and refer for specialist assessment[1,19][**L2, RGB**].

8.2 Additional Investigations

Also, consider performing the following tests, if indicated:

- Tests for atopy:
    - Skin-prick testing for inhaled allergens[1,13][**L2, RGA**].
    - Serum specific IgE levels for inhaled allergens[1,13][**L2, RGA**].
    - Serum total IgE levels[1,13][**L1, RGA**].

- Fractional Exhaled Nitric Oxide (FE_{NO}) testing[1,2,13,19,24–27][**L1 RGA**]:
    - FE_{NO} is a non-invasive marker of airway inflammation in asthma.
    - Indicative of eosinophilic asthma and levels are raised in eosinophilic airway inflammation.

  - Recommended as an option to help diagnose asthma in children who are considered to have an intermediate probability of asthma, and when FE_{NO} testing is to be done in combination with other diagnostic tests.
  - Further investigation is recommended if FE_{NO} test result is negative as a negative result does not exclude asthma.
  - In children, FE_{NO} guided treatment can decrease the frequency of exacerbations.
  - Can predict ICS efficacy.

- Induced sputum differential eosinophil count[1][**L1, RGA**].

- Chest radiography.
  - Reserve chest radiographs for children with severe disease or clinical clues suggesting other conditions[1,13][**L2, RGA**].

- CBC with differential.
  - Used to assess for peripheral eosinophilia[1][**L1, RGA**].

- Broncho-provocation testing (e.g. methacholine challenge testing)[1][**L1, RGA**]:
  - Used to assist in the diagnosis of asthma.
  - A negative test effectively excludes asthma.

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9 Differential Diagnosis

The differential diagnosis of asthma in children, includes[1–4,8,19]:

- Viral-induced wheeze:
    - Improves with age, usually benign, though can in some cases indicate asthma.
    - Almost all exacerbations are due to viral infection therefore it will not be possible to distinguish between an asthmatic and an infant with a transient viral wheeze.
    - The best indicators for asthma are associated atopy and positive allergy test results.
- Bronchiolitis.
- Pneumonia.
- Gastro-oesophageal reflux.
- Inhaled foreign body.
- Aspiration pneumonitis.
- Congenital abnormalities:
    - Vascular rings.
    - Tracheomalacia.
    - Congenital lobar emphysema.
- Cystic fibrosis.
- Vocal cord dysfunction:
    - Uncommon in younger children.
    - A common superimposed event in adolescents with genuine asthma.

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10 Management of an Acute Exacerbation of Asthma

An acute exacerbation of asthma is diagnosed on the basis of the clinical presentation and history (see *Sections 5.1* and *6*). A presentation of an acute exacerbation may be classified according to the degree of respiratory distress that is observed[1]. The main classifications of an acute exacerbation of asthma are as follows. Each is discussed in the following sections and addressed by the age of the child:

- Life-threatening exacerbation of asthma.
- Severe exacerbation of asthma.
- Mild to moderate exacerbation of asthma.

Except for mild exacerbations, early referral to a **Paediatric Emergency Centre** is strongly recommended as asthma is a preventable cause of death in children [**R-GDG**]. Initial treatment of the patient should be started with high flow oxygen and nebulised beta$_2$-agonists, whilst awaiting ambulance transfer. Start systemic corticosteroids, if available[1][**L1, RGA**].

10.1 Life-Threatening Exacerbation of Asthma

The table below outlines the diagnosis and management of a life-threatening exacerbation of asthma in children aged 2-5 years and over 5 years.

	Child aged 2-5 years	Child over 5 years
Definition	SpO_2 less than 92% plus any of: • Silent chest. • Poor respiratory effort. • Bradycardia. • Agitation. • Altered consciousness. • Cyanosis.	SpO_2 less than 92% plus any of: • Silent chest. • Poor respiratory effort. • Agitation. • Altered consciousness. • Cyanosis. • PEFR less than 33% best or personal best.

Management	• Oxygen therapy to achieve $Sp0_2$ > 94%.
	• Nebulised beta$_2$-agonists:
	  ○ 2.5mg salbutamol plus 0.25mg ipratropium bromide nebulised; or
	  ○ 5mg terbutaline plus 0.25mg ipratropium bromide nebulised.
	• Repeat every 20 minutes and reassess the patient.
	• Systemic corticosteroids:
	• Oral prednisolone 1-2 mg/kg/day (up to a maximum of 40mg/day); or
	• IV methylprednisolone 1mg/kg/day (up to a maximum of 40mg/day).
	• Consider referral to PICU if patient is not responding to treatment.
		• Oxygen therapy to achieve $Sp0_2$ > 94%.
		• Nebulised beta$_2$-agonists:
		  ○ 5mg salbutamol plus 0.25mg ipratropium bromide nebulised; or
		  ○ 10mg terbutaline plus 0.25mg ipratropium bromide nebulised.
		• Repeat every 20 minutes and reassess the patient.
		• Systemic corticosteroids:
		  ○ Oral prednisolone 1-2 mg/kg/day (up to a maximum of 50mg/day); or
		  ○ IV methylprednisolone 2mg/kg/day (up to a maximum of 50mg/day).
		• Consider referral to PICU if patient is not responding to treatment.

Table 10.1: Diagnosis and management of a life-threatening exacerbation of asthma[1–4].

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10.2 Severe Exacerbation of Asthma

The table below outlines the diagnosis and management of a severe exacerbation of asthma in children aged 2-5 years and over 5 years.

	Child aged 2-5 years	Child over 5 years
Definition	• SpO_2 less than 92% in air. • Unable to feed, speak, or complete sentences in one breath. • Accessory muscle usage. • Heart rate more than 140 beats per minute. • Respiratory rate more than 40 breaths per minute.	• SpO_2 less than 92% in air. • PEFR 33-50% best or predicted. • Unable to feed, speak, or complete sentences in one breath. • Accessory muscle usage. • Heart rate more than 125 beats per minute. • Respiratory rate more than 30 breaths per minute.

Initial Management	• Oxygen therapy to achieve $Sp0_2$ > 94%.
	• $Beta_2$-agonists.
	  ○ 4-8 puffs, every 20 minutes of salbutamol via spacer with or without face mask; or
	  ○ 2.5mg nebulised salbutamol; or,
	  ○ 5mg nebulised terbutaline.
	• Repeat $beta_2$-agonist every 20 minutes according to response for up to 1 hour.
	• Repeat $beta_2$-agonist via nebuliser with additional nebulised 0.25mg ipratropium bromide every 20 minutes for the next hour.
	• Systemic corticosteroids.
	  ○ Oral prednisolone 1-2 mg/kg/day (up to a maximum of 40mg/day); or
	  ○ IV methylprednisolone 1mg/kg/day (up to a maximum of 40mg/day).
	• Consider referral to PICU if patient is not responding to treatment.
	• Repeat assessments after bronchodilator inhalation and determine subsequent management according to the response.
		• Oxygen therapy to achieve $Sp0_2$ > 94%.
		• $Beta_2$-agonists.
		  ○ 4-8 puffs, every 20 minutes of salbutamol via spacer; or
		  ○ 2.5-5mg nebulised salbutamol; or,
		  ○ 5-10mg nebulised terbutaline.
		• Repeat $beta_2$-agonist every 20 minutes according to response for up to 1 hour.
		• Repeat $beta_2$-agonist via nebuliser with additional nebulised 0.5mg ipratropium bromide every 20 minutes for the next hour.
		• Systemic corticosteroids.
		  ○ Oral prednisolone 1-2 mg/kg/day (up to a maximum of 50mg/day); or
		  ○ IV methylprednisolone 2mg/kg/day (up to a maximum of 50mg/day).
		• Consider referral to PICU if patient is not responding to treatment.
		• Repeat assessments after bronchodilator inhalation and determine subsequent management according to the response.

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	Child aged 2-5 years	Child over 5 years

Subsequent Management	In all patients who fail to respond to treatment and begin to develop life-threatening features:
	• Discuss urgently with senior clinician, PICU team and/or paediatrician.
	• Consider the use of the following with concurrent cardiac monitoring:
	  ○ IV salbutamol under specialist advice, in patients not responding to maximal inhaled therapies (monitor serum lactate for toxicity).
	  ○ IV magnesium sulphate 25-50mg/kg via slow IV over 10-20mins (up to a maximum of 2 grams).
	  ○ Anaesthetic inhalation (sevoflurane) to correct high levels of $PaCO_2$.
	• Consider blood gases measurements.
	
	Perform a chest radiograph if:
	• Subcutaneous emphysema.
	• Persisting unilateral signs suggesting non-tension pneumothorax.
	• Consolidation and/or life-threatening asthma not responding to treatment.	

Table 10.2: Diagnosis and management of a severe exacerbation of asthma[1–4].

10.3 Mild to Moderate Exacerbation of Asthma

The table below outlines the diagnosis and management of a mild to moderate exacerbation of asthma in children aged 2-5 years and over 5 years.

	Child aged 2-5 years	Child over 5 years
Definition	• Able to speak in sentences. • Heart rates equal to or less than 140 beats per minute. • Respiratory rate equal to or less than 40 breaths per minute.	• PEFR equal to or more than 50% best or predicted. • Able to speak in sentences. • Heart rates equal to or less than 125 beats per minute. • Respiratory rate equal to or less than 30 breaths per minute.

Management	• $Beta_2$-agonists:
	  ○ 2 puffs of salbutamol via spacer with or without face mask – given in single puffs with tidal breathing and inhaled separately.
	  ○ Give additional 2 puffs of $beta_2$-agonist, every 2 minutes, up to a maximum of 8 puffs according to the response.
	• Consider systemic corticosteroids:
	  ○ Oral prednisolone 1-2 mg/kg/day (up to a maximum of 40mg/day).
	• Reassess within 1 hour[1].	

Table 10.3: Diagnosis and management of a severe exacerbation of asthma[1–4].

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10.4 Consider Discharging the Patient

For children aged less than 5 years, clinical assessment of the degree of respiratory distress can be used to determine suitability for discharge from the Emergency Department or Paediatric Emergency Centre [**R-GDG**].

Children aged over 5 years may be discharged if their PEFR is >75% of their personal best or predicted one hour after treatment, unless any of the following are present[1][**L2, RGA**]**:**

- Continuing presence of significant symptoms.
- Concerns about medication compliance.
- Child lives alone.
- Psychological problems.
- Physical disability or learning difficulties.
- Previous near fatal or brittle asthma.
- Exacerbation occurred despite pre-presentation compliance with adequate oral steroid use.
- Presentation at night.

If the patient is to be discharged, an appropriate discharge plan should include the following[1]:

- Continue beta$_2$-agonist 4 hourly as required[1][**L2, RGA**].
- Consider oral prednisolone[1][**L2, RGA**]:
    - Child age 2-5 years – prednisolone 20mg daily for up to 3 days.
    - Child age over 5 years – prednisolone 30-40mg daily for up to 3 days.
    - Advise the parent or carer to contact the child's primary care physician, for follow-up.
- Provide a written asthma action plan[1–4,6][**L2, RGA**].
- Review regular treatments.
- Check inhaler technique.
- Assess exposure to tobacco smoke
- Identify the trigger for acute attack and put a management plan for future exposure.
- Provide discharge summary to primary care physician with plan for follow up in primary care [**R-GDG**].

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11 Management of Chronic Asthma

A diagnosis of asthma is primarily clinical and based upon the history and examination findings. An assessment of the probability of an asthma diagnosis should be made in order to determine appropriate next steps in the patient's management.

11.1 Assessing the Probability of an Asthma Diagnosis

Assessment of the probability of asthma, is based on the findings of both history and examination.

Clinical features that increase the probability of asthma are[1,4,6,8]:

- The presence of more than one of the following reported symptoms:
  - Wheeze.
  - Cough.
  - Difficulty breathing.
  - Chest tightness.
- Probability is increased if the symptoms above:
  - Are frequent and recurrent.
  - Are worse at night and in the early morning.
  - Occur in response to, or are worse after, exercise or other triggers, such as exposure to pets, cold or damp air, or with emotions or laughter.
  - Are not associated with an Upper Respiratory Tract Infection (URTI).
- Personal history of atopic disorder.
- Family history of atopic disorder and/or asthma.
- Widespread wheeze heard on auscultation.
- History of improvement in symptoms or lung function in response to adequate therapy.

Clinical features that lower the probability of asthma[1,4,6,8]:

- Symptoms associated with URTIs only, with no symptoms between URTIs.
- Isolated cough in the absence of wheeze or difficulty breathing.
- History of productive cough.
- Prominent dizziness, light-headedness, peripheral tingling.
- Repeatedly normal physical examination of chest when symptomatic.
- Normal PEFR or spirometry when symptomatic.
- No response to a trial of asthma therapy.
- Clinical features pointing to alternative diagnosis.

11.1.1 High Probability of Asthma

In children with a high probability of asthma[1]:

- Start a trial of treatment[1][**L2, RGA**].
- Review and assess response to treatment[1][**L2, RGA**].
- Reserve spirometry for those patients who are classified as having severe asthma or who have a poor response to treatment. In these cases spirometry is necessary in order to confirm the diagnosis and establish a baseline measure to guide management of the patient[1][**L2, RGA**].

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11.1.2 Intermediate Probability of Asthma

In some children there is insufficient evidence at the first consultation to make a firm diagnosis. In these cased consider the following approaches to aid in reaching a diagnosis[1][**L2, RGA**]:

- Watchful waiting.
- Trial of treatment with review.
- Spirometry and reversibility testing.

11.1.2.1 Watchful Waiting

Consider watchful waiting for those children with mild, intermittent wheeze or other respiratory symptoms which occur only with URTIs[1]. In such cases, review the child as appropriate and agree an approach to further management with parents or carers.

11.1.2.2 Trial of Treatment to aid Diagnosis

The choice of a trial treatment will depend on the frequency and severity of symptoms, but options include[1][**L2, RGA**]:

- Trial of a short-acting inhaled bronchodilator as required for 4-6 weeks.
- Trial of a regular inhaled corticosteroid for 4-6 weeks, in combination with a short-acting inhaled bronchodilator, as required.

Review the child's response to treatment[1]:

- Improvement in symptoms may be due to spontaneous remission.
- Evaluate the child while treatment is withdrawn, to assess response to therapy.
- Treat as appropriate:
    - If the trial of treatment is beneficial, manage as asthma and arrange review.
    - If the trial of treatment is not beneficial, consider stopping asthma treatment and consider tests for alternative conditions and/or specialist referral.

11.1.2.3 Spirometry and Reversibility Testing

Spirometry is recommended for children with an intermediate probability of asthma if they are able to perform the test (usually older than age 5 years)[1]. If the test reveals airway obstruction, assess the response to treatment by repeating the lung function test. However, a normal result obtained when the child is asymptomatic does not exclude a diagnosis of asthma and require further challenge tests[1][**L2, RGA**].

11.1.3 Low Probability of Asthma

In children with a low probability of asthma, consider further investigations – this may require referral for specialist assessment (see *Section 8*)[1,6,8,25]. Reconsider a diagnosis of asthma in those who do not respond to specific treatments for non-asthmatic conditions[1].

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11.2 Principles and Aims of Treatment

The principles and aims of treatment are[1–4]:

- Normalisation of everyday activities.
- Regular exercise unlimited by disease.
- Optimisation of lung function – in practical terms FEV1 and/or PEF>80% of predicted or best.
- Relief of chronic symptoms with minimal medication.
- Little or no need for beta$_2$-agonists medication i.e. less than 2-3 times/week.
- Prevention or decrease of acute exacerbations.
- Minimisation of sleep disruption.
- Minimisation of drug side effects.
- Education and involvement of child and family in management.

11.3 Routine Consultations

On at least an annual basis, a routine review should be conducted to ensure the following are addressed[1]:

- Asthma control.
- Education.
- Medication compliance and inhaler technique.
- Immunisation status.
- Parent/carer smoking avoidance.
- Complementary and alternative therapies.
- Other factors (see below).

11.3.1 Review Asthma Control

Asthma control should be reviewed and assessed using the table in *Section 11.5.*

Factors that should be monitored and recorded include[1–4,6]:

- Symptom score:
    - Children's Asthma Control Test for 4-11 year olds.
    - Asthma Control Questionnaire – validated in children over age 5 years.
- Exacerbations, oral corticosteroid use and time off school/nursery due to asthma since last assessment.
- Inhaler technique.
- Compliance – which can be assessed by reviewing prescription refill frequency.
- Possession of and use of self-management plan/personalised asthma action plan.
- Exposure to tobacco smoke.
- Growth – height and weight centile.
- Immunisation status.

Discuss the following:

- Potential trigger factors[1–4,6]:
    - Respiratory infections, most commonly viruses. Fungi, bacteria, or parasites may also be trigger factors responsible in some people.
    - Allergens, e.g. pollen, dust mites, and feathered or furry animals.
    - Airborne irritants, e.g. cigarette smoke, irritant dusts.
    - Weather changes, e.g. cold air exercise.
    - Emotional factors, such as stress or laughing.
    - Gastro-oesophageal reflux disease
    - Allergic rhinitis and sinusitis.

- Psychological well-being.
    - Ask about actual participation in sport and encourage this where possible.
    - Establish record of school absence.

11.3.2 Education

If required provide information on[1–4][**L3, RGB**].

- Basic facts about asthma.
- How medications work.
- Inhaler technique (see *Section 11.3.3*).
- Written action plans based on home peak flow rate monitoring or symptom diary.
- Environmental control measures.
- Need for regular follow-up visits.

Technology enabled healthcare such as telemonitoring, automated reminders, and computer-based educational games to improve knowledge on asthma can be considered as options to support the management. These can improve different outcomes including adherence to monitoring, self-management skills and increased used of preventer medication [28–35].

11.3.3 Medication Compliance and Inhaler Technique

Before initiating a new pharmacological therapy check compliance with existing therapies[1–4]:

- Establish how often a bronchodilator or corticosteroid is used.
- Assess whether the bronchodilator or corticosteroid is age appropriate.
- Establish which medication is being used.
- Assess whether medication is being used optimally for the patient's symptomatology, e.g. if wheeze is exercise-induced, check if a beta$_2$-agonists is used prior to exercising.
- Assess patient compliance with medication.
- Ensure the patient/parent/carer, knows how to clean the spacer device.
- Review and re-demonstrate appropriate bronchodilator or corticosteroid or spacer device technique.
- Watch and correct patient or parent use of the bronchodilator or corticosteroid and spacer device.
- Ensure pressurised metered dose inhaler (pMDI) and spacer devices are age-appropriate and compatible.
- For school-age children, individual choice of inhaler device in important (see *Section 11.3.4*).

11.3.4 Choice of Inhaler Device

In addition to therapeutic need, including chosen drug and dose, take into account the following factors when choosing inhaler devices for individual children with chronic asthma[36,37]:

- The ability of the child to develop and maintain an effective technique with the specific device.
- The suitability of a device for the child's and carer's lifestyles, considering factors such as portability and convenience.
- The child's preference for and willingness to use a particular device.

There are a variety of inhaler devices that can be used[36,37]:

- Pressurised Metered Dose Inhalers (pMDIs) should be combined with a spacer device.
- Breath-actuated pressurised metered dose aerosol inhalers.
- Dry powder inhalers (DPIs).

On selection of an inhaler device, it is important that consideration is given to other aspects of asthma care that influence the effective delivery of inhaled therapy, including[37]:

- Individual practical training in the use of the specific device.
- Monitoring of effective inhaler technique and adherence to therapy.
- Regular, i.e. no less than annual, review of inhaler needs, which may change over time with increasing age.

Recommended device choices for children of under age 5 years[37][**L3, RGA**].

- Child aged 0-2 years:
    - First choice device: pMDI + spacer + face mask.
    - Second choice device: Nebuliser (rarely needed)
    - Avoid breath actuated inhalers
    - Avoid dry powder inhalers.

- Child aged 3-5 years[37][**L3, RGA**].
    - First-choice device: pMDI + spacer
    - Second choice device: pMDI + spacer + facemask
    - Third choice device: Nebuliser (rarely needed)
    - Breath actuated inhalers are not proven to be of benefit.
    - Dry powder inhalers may be used for possible $beta_2$-agonists but are not recommended for corticosteroids.

11.3.5 Immunisation Status

Immunisations should be administered independently of any considerations related to asthma. However response to vaccines may be attenuated by high-dose inhaled corticosteroids[1]. All asthmatics should be encouraged to receive the influenza vaccine[1–4][**L2, RGA**].

11.3.6 Parent or Carer Smoking Avoidance

Exposure to tobacco smoke in the home contributes to increased wheezing in infancy, increased risk of persistent asthma, and increased severity of childhood asthma[1]. Advise parents or carers of children with asthma about the danger of passive smoking. Offer parents or carers support to stop smoking [**R-GDG**].

11.3.7 Other Factors

Other factors to discuss, include[1,6,18,38–40]:

- Weight reduction is recommended in obese patients with asthma to promote general health and to improve asthma control.
- Immunotherapy can be considered in patients with asthma where a clinically significant allergen cannot be avoided – discuss with patients the potential for severe allergic reactions to the therapy.
- In difficult childhood asthma, there may be a role for family therapy as an adjunct to pharmacotherapy.
- Nutritional supplementation with vitamin D and fish oil might reduce the risk of wheezing and asthma exacerbations [3,30,41–43].

11.4 Classification of Severity in Chronic Asthma

The classification of severity of chronic asthma is according to the degree of symptomatic control that the patient experiences and is used to guide step-wise management of the patient.

Table 11.4 below outlines the classification of severity in chronic asthma:

Components of SEVERITY		Age (years)	Classification of Asthma SEVERITY (Intermittent vs. Persistent)			
			Mild Intermittent	Persistent		
				Mild	Moderate	Severe
Impairment	Symptoms	All	≤ 2 days/week	> 2 days/week but not daily	Daily	Throughout the day
	Nighttime awakenings	0-4	0	1–2x/month	3–4x/month	> 1x/week
		≥5	≤ 2x/month	3–4x/month	> 1x/week but not nightly	Often 7x/week
	Short-acting Beta$_2$-agonist use for symptom control	All	≤ 2 days/week	> 2 days/week but not daily	Daily	Several times a day
	Interference with normal activity	All	None	Minor limitation	Some limitation	Extremely limited
	Lung function: FEV1 (predicted) or PEFR (personal best)	≥5	Normal FEV1 between exacerbations > 80%	> 80%	60–80%	< 60%
	FEV1/FVC	5-11	> 85%	> 80%	75–80%	< 60%
		≥12	Normal	Normal	Reduced 5%	Reduced > 5%
Risk	Exacerbations requiring oral corticosteroids	0-4	≤ 1x/year	≥ 2x in 6 months or ≥ 4 wheezing episodes/year lasting > 1 day AND risk factors for persistent asthma		
		5-11		≥ 2x/year Consider severity and interval since last exacerbation. Frequency and severity may fluctuate over time for patients in any severity category. Relative annual risk of exacerbations may be related to FEV1.		
		≥12				

Table 11.4: Classification of severity of chronic asthma[6].

11.5 Classification of Asthma Control

Table 11.5 below, provides a classification of chronic asthma control to assist in guiding the physician to determine whether to step-up or step-down treatment.

Components of CONTROL		Age (Years)	Level of Asthma CONTROL		
			Well Controlled	Not Well Controlled	Very Poorly Controlled
Impairment	Symptoms	0 – 4	≤ 2 days/week but ≤ 1x/day	> 2 days/week or multiple times on ≤ 2 days/week	Throughout the day
		5 – 11			
		≥ 12	≤ 2 days/week	> 2 days/week	
	Nighttime awakenings	0 – 4	≤ 1x/month	> 1x/month	> 1x/week
		5 – 11		≥ 2x/month	≥ 2x/week
		≥12	≤ 2x/month	1–3x/week	≥ 4x/week
	Interference with normal activity	All	None	Some limitation	Extremely limited
	SABA use for symptoms	All	≤ 2 days/week	> 2 days/week	Several times per day
	Lung function: FEV1 (predicted) or PEFR (personal best)	≥ 5	> 80%	60-80%	< 60%
	FEV1/FVC	5 – 11	> 80%	75-80%	< 75%
Risk	Exacerbations requiring oral corticosteroids	0-4	≤ 1x/year	2-3x/year	> 3x/year
		5-11		≥ 2x/year Consider severity and interval since last exacerbation	
		≥12			
	Reduction in lung growth	5-11	Evaluation requires long-term follow-up care		
	Loss of lung function	≥12	Evaluation requires long-term follow-up care		
	Treatment-related adverse effects	All	Medication side effects can vary in intensity from none to very troublesome and worrisome.		

Table 11.5: Classification of Asthma control[6].

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11.6 Step-Wise Management of Chronic Asthma

11.6.1 Step 1 - Mild Intermittent Asthma

Short-acting beta$_2$-agonist[1–4,44][L2, RGA]:

- Prescribe an inhaled short-acting beta$_2$-agonist as short term reliever therapy for all patients with symptomatic asthma.
- In children < 2 years with poor initial response to adequately administered SABA, consider alternative diagnosis or a different treatment.

11.6.2 Step 2 - Regular Asthma Preventative Therapy

Inhaled corticosteroids[1–4,44][L2, RGA]:

- Are the most effective preventative medication for achieving overall treatment goals.
- There is increasing evidence demonstrating that inhaled corticosteroids are safe and effective in younger children.
- Consider regular inhaled corticosteroids in patients[1] with persistent symptoms classified as mild, moderate or severe (see *Table 11.4*).

Starting dose of inhaled corticosteroids[1–4,44]:

- Start patients at a dose of inhaled corticosteroids appropriate to the severity of disease.
- Titrate the dose of inhaled corticosteroid to the lowest dose at which effective control of asthma is maintained.

Frequency of dosing of inhaled corticosteroids[1–4,44]:

- Give inhaled corticosteroids initially twice daily, except budesonide and ciclesonide which can be given once daily.
- Once-a-day inhaled corticosteroids at the same total daily dose can be considered if good control is established.

Safety of inhaled corticosteroids[1,44,45]:

- Record baseline height and weight.
- Monitor height and weight annually.
- For school age children, individual choice of inhaler device is important.

If inhaled corticosteroid cannot be tolerated, consider[1,44,45]:

- Leukotriene receptor antagonist (use as sole initial maintenance in those under age 5 years).
- Theophyllines may be used under the direction of an asthma-specialised physician [**R-GDG**].

If the patient is well-controlled (as defined in *Table 11.5*)[1,44,45]:

- Decrease dose to minimum effective for that patient.
- Regular review of patients during this process is important.
- Reduce dose of inhaled corticosteroid slowly:
    - Consider reduction every 3 months.
    - Decrease the dose by approximately 25-50% each time.

Inadequate control:

- Consider fractional exhaled nitric oxide (FE_{NO}) testing[1,25] to support asthma management in people who are symptomatic despite using inhaled corticosteroids (see *Section 8*).
- Consider moving to Step 3 management.
- Add sublingual immunotherapy (SLIT) in house dust mites (HDM) allergic rhinitis patients with FEV_1 70% predicted [3,30,46].

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11.6.3 Step 3 - Add-On Therapy

Add-on therapy should ideally be phenotype-specific, thus the need for phenotype differentiation to assess the best treatment option [3,47,48].

Child aged under 2 years:

- Refer all children aged under 2 years with uncontrolled asthma at Step 2, to an asthma-specialised paediatrician for outpatient review of management [**R-GDG**].

Child aged 2-5 years:

- Consider the following add-on therapies[1]:
  - Leukotriene receptor antagonist (if already taking inhaled corticosteroids).
  - Reconsideration of inhaled corticosteroids (if taking leukotriene receptor antagonist).
  - Use lowest dose that controls symptoms.

Child aged over 5 years – Add in long acting beta$_2$-agonist (LABA):

- Add on therapy to inhaled corticosteroids for children aged over 5 years[1–4,6][**L2, RGA**]:
  - The first choice is an inhaled LABA.
  - LABAs should only be started in patients who are already on inhaled corticosteroids, and the inhaled corticosteroid should be continued.
  - Salmeterol or formoterol can be used (dose depends on age, device used and severity of symptoms).
  - Allow 4-6 weeks trial of new treatment before considering referral for lack of response.

Inadequate control:

- If there is a response but asthma control remains suboptimal[1]:
  - Continue LABA; and
  - Increase the dose of inhaled corticosteroids.
- If there is no response to the LABA[1–4]:
  - Stop the LABA.
  - Increase the dose of inhaled corticosteroids.
- If control remains inadequate thereafter, consider[1–4]:
  - Leukotriene receptor antagonist.
  - Theophyllines may be used under the direction of an asthma-specialised physician [**R-GDG**].
- If control remains inadequate go to Step 4.

If control is achieved, stepwise reduction in therapy may be possible[1–4]:

- Decrease dose to minimum effective for that patient.
- Regular review of patients during this process is important.
- Decide which drug to step down first and at what rate – consider:
  - Severity of asthma.
  - Side effects of the treatment.
  - Time on current dose.
  - Beneficial effect achieved.
  - Patient's preference.
- Reduce dose of inhaled corticosteroid slowly[45]:
  - Consider reduction every 3 months.
  - Decrease the dose by approximately 25-50% each time.

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11.6.4 Step 4 - Persistent Poor Control

Child aged less than 5 years:

- Refer to asthma-specialised paediatrician for specialist assessment and management.

Child aged over 5 years:
If asthma control remains suboptimal[1–4]:

- Continue inhaled LABA; and
- Increase the dose of inhaled corticosteroids.

If control remains inadequate after increasing the dose of inhaled corticosteroid consider[1,45]:

- Further increase of inhaled corticosteroid:
    - Any child on doses of 800 micrograms/day or more of beclomethasone or equivalent should be under the care of an asthma-specialised paediatrician for the duration of the treatment, owing to risk of systemic side effects [**R-GDG**].
- Consider trial of other add-on therapy[1–4,6]:
    - Leukotriene receptor antagonist.
    - Theophyllines.
    - Long acting muscarinic antagonists (LAMA) such as tiotropium bromide in children ≥6 years[1,3,30,49,50].

NB: Before preceding to Step 5 (continuous or frequent use of oral steroids), refer patients with inadequately controlled asthma to specialist care[1–4].

11.6.5 Step 5 – Oral Corticosteroids

Child aged over 5 years:
For the small number of patients not controlled at Step 4, use daily corticosteroid tablets in the lowest dose providing adequate control[1–4,45].

Corticosteroid formulations[1–4,45]:

- Prednisolone is the most widely used corticosteroid tablet for maintenance therapy in chronic asthma.
- Patients on long-term corticosteroid tablets or requiring frequent courses of corticosteroid tablets should have the following monitored for long-term corticosteroid complications:
    - Blood pressure.
    - Cholesterol
    - Urine or blood glucose.
    - Bone mineral density.
    - Growth.
    - Screen for cataracts – through community optometric services.

Corticosteroid tablet-sparing medication[1–4,45]:

- Aim to control using lowest dose or to stop oral corticosteroids with a 6 weeks trial of:
    - Inhaled corticosteroids – careful consideration required for dose above 800micrograms/day.
    - Long-acting beta$_2$-agonists.
    - Leukotriene receptor antagonists.
    - Theophyllines.
- Stop treatment if there is no improvement in symptoms or lung function[1].

- Alternative therapies should only be used in a suitably experienced specialist centre in a 3 months trial when other treatments have failed[1,3,30,51–57]:
    - Omalizumab for patients ≥6 years with severe allergic asthma or with high steroid burden
    - Ciclosporin
    - Methotrexate
    - Anti-IL5 therapy (subcutaneous mepolizumab or benralizumab) in patients ≥12 years with severe eosinophilic asthma.

11.6.6 Exercise-Induced Asthma

For most patients, exercise-induced asthma is an expression of poorly controlled asthma and regular treatment including inhaled corticosteroids should be considered[1–4,19].

Immediately prior to exercise, inhaled short-acting beta$_2$-agonists are the drug of choice[1,19]. Treatment with relievers such as short-acting beta$_2$-adrenoceptor agonists (SABAs) or anticholinergics, administered 10-15 minutes before exercise is the most preferable method of preventing exercise-induced bronchoconstriction in asthmatic children.

If exercise is a specific problem in patients taking inhaled corticosteroids who are otherwise well controlled, consider the following therapies[1,19]:

- Leukotriene receptor antagonists.
- Long-acting beta$_2$-agonists.
- Theophylline may be used under the direction of an asthma-specialised physician.

11.7 Follow-Up

All patients should be reviewed by their primary care physician within one week of an acute exacerbation of asthma and on at least an annual basis to review overall asthma control if asthma is stable[1][**L2, RGA**]. Specialist supervision is indicated in cases warranting Step 4 or 5 treatment or where the diagnosis is uncertain [**R-GDG**].

View Pathway

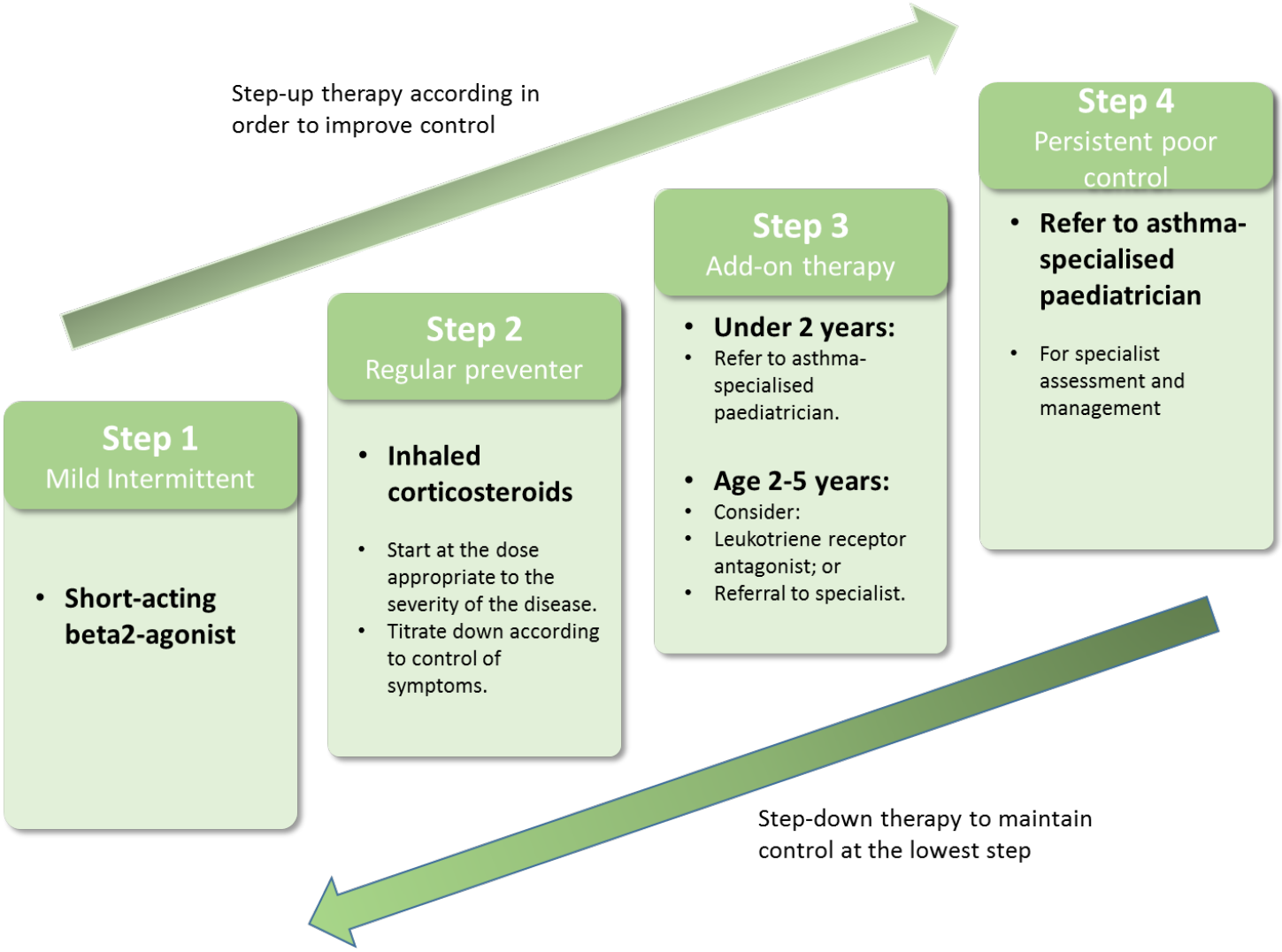

Fig 11.6(1): Step-wise management of asthma in children aged under 5 years (Adapted from[1]).

View Pathway

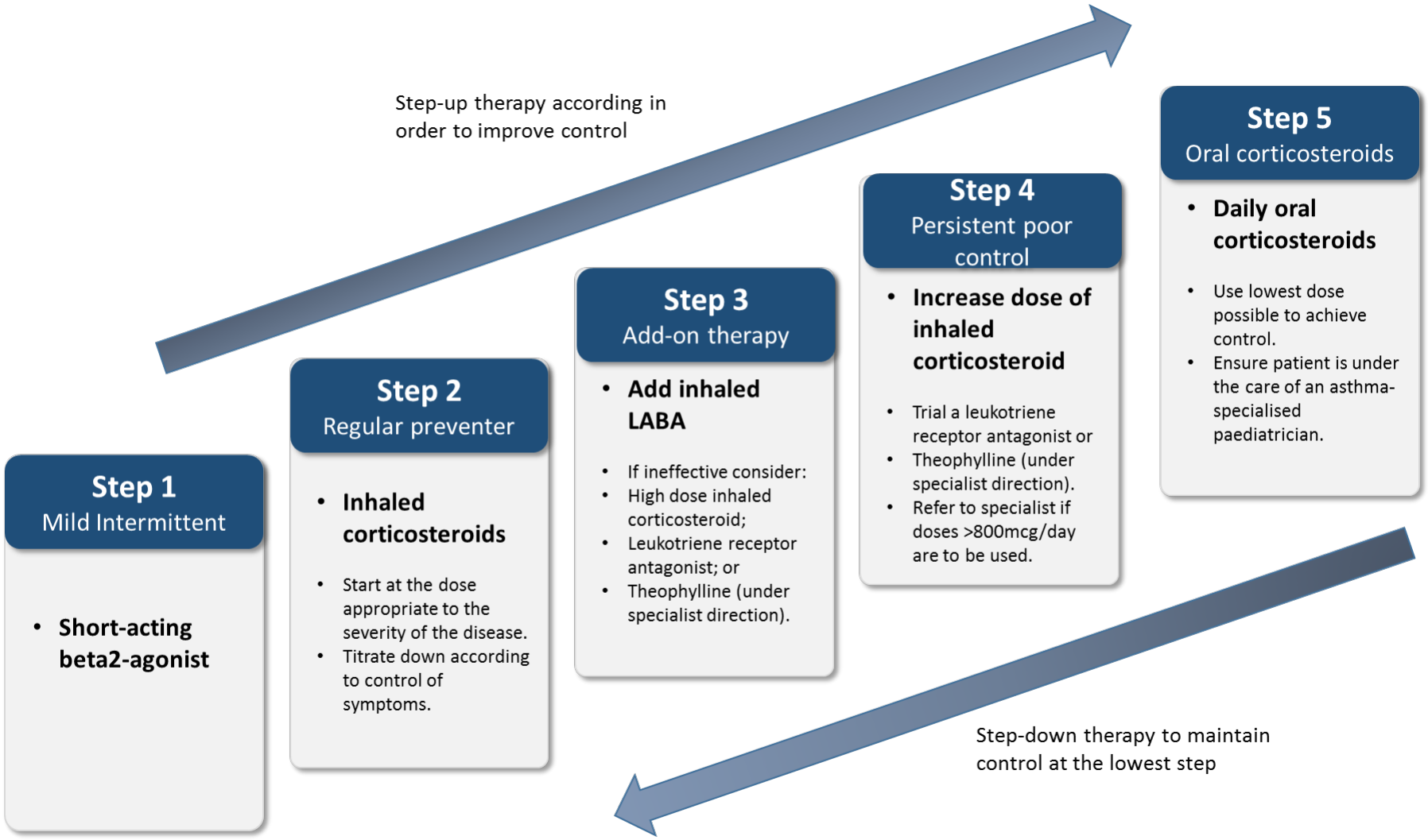

Fig 11.6(2): Step-wise management of asthma in children aged over 5 years (LABA: Long-acting beta$_2$-agonist) (Adapted from[1]).

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12 Inpatient Management

Management of acute exacerbations of asthma is described in *Section 10*.

12.1 Observation Care Criteria

Observation care e.g. in the Emergency department or Medical Assessment Unit, may be appropriate for patient with moderate to severe asthma with any of the following[1–5,58][**L1, RGA**]:

- Significant asthma exacerbation in a child that persists after treatment as indicated by the following:
    - Patient has received acute treatment for 1 to 2 hours.
    - Significant findings persist, as indicated by any of the following:
        - Persistent tachypnoea.
        - Continued accessory muscle use.
        - Continued retractions.
        - Patient unable to complete full sentences in one breath.
        - Peak flow less than 60% of best or predicted.
        - Airflow measurement less than 70% of predicted or personal best and identified risk factor indicated by any of the following:
            - History of sudden severe asthma exacerbation.
            - History of intubation for asthma.
            - Previous inpatient admission for asthma in past 12 months.
            - Three or more emergency care visits for asthma in past 12 months.
            - Hospital or emergency care visit for asthma in past month.
            - Use of more than 2 canisters of short-acting inhaled beta2-agonist per month.
            - Inadequate access to medical care or medications.
            - Difficulty in obtaining transportation to hospital in event of further deterioration.
            - Difficult home circumstances that do not allow for adequate home care.
            - Comorbidities, such as cardiovascular disease or other chronic lung disease.

12.2 Inpatient Admission Criteria

Inpatient admission is indicated for any of the following[1–4,6,7][**L1, RGA**]:

- Ventilatory support required.
- Peak expiratory flow rate less than 25% of predicted or personal best, before treatment.
- Peak expiratory flow rate less than 40% of predicted or personal best, after treatment.
- Oxygen saturation less than 92%.
- $Pa0_2$ less than 60 mmHg (8.0 kPa).
- $PaC0_2$ of greater than or equal to 42 mmHg (5.6 kPa).
- Cyanosis.
- Silent chest (absent or markedly diminished breath sounds).
- Bradycardia or other cardiac dysrhythmia or haemodynamic instability.
- Change in mental status.
- Radiographic evidence of complication requiring inpatient treatment (e.g., pneumonia, pneumothorax).
- Inpatient admission required rather than observation because of:
    - Significant finding or clinical condition judged too severe (e.g., treatment intensity or expected duration requires inpatient admission) or too persistent (e.g., insufficient

improvement or worsening despite initial intervention or treatment for up to 24 hours) to be within scope of observation care, including any of the following:
    - Respiratory finding that is severe or persistent (e.g. dyspnoea, tachypnoea, retractions, accessory muscle use).
    - Airflow measurements less than 60% of predicted or personal best that persist (e.g., over 24 hours) or worsen despite treatments.
    - Other significant finding or clinical condition judged not to be within scope of observation care.
- Treatment or monitoring requiring inpatient admission (e.g., due to intensity or expected duration) as indicated by a need for either:
    - Supplemental oxygen or respiratory treatments for over 24 hours that are performable only in acute inpatient setting.
    - Other treatment or monitoring requiring inpatient admission.

12.3 Indications for PICU Admission

Admission to PICU is appropriate for any of the following[1,3,7][**L1, RGA**]:

- Patients with a poor response to therapy.
- Persistent severe respiratory distress.
- Impending or actual respiratory arrest.
- Need for assisted ventilation.
- Persistent or worsening hypoxia.
- Acidosis.
- Hypercapnia.
- Drowsiness, confusion or coma.
- Requirement for continuous inhaled bronchodilators.

12.4 Goal Length of Stay

Patients should ideally be managed on an outpatient basis or in an observation care setting. However if inpatient admission is indicated, the optimal length of stay for admission is 1 day[5][**L3**].

12.5 Extended Stay Criteria

Extended stay is classified as:

- Minimal stay (a few hours to 1 day)
- Brief (1 to 3 days)
- Moderate (4 to 7 days)
- Prolonged (more than 7 days).

Extended stay, beyond goal length of stay, may be needed for:

- Severe respiratory failure[7,59–61]:
    - Anticipate possible non-invasive positive pressure ventilation or intubation and mechanical ventilation.
    - Patients requiring IV medication infusions, mechanical ventilation, or non-invasive ventilation for severe exacerbation or status asthmaticus may require prolonged therapy before adequate response is obtained.

    - Anticipate intense bronchodilator treatment with frequent or continuous nebulization of beta2-agonists, inhaled anticholinergic agents, and intravenous beta2-agonists.
    - Expect brief to moderate stay extension.
- Status asthmaticus[62–64]:
    - Failure to respond to conventional treatment may require general anaesthesia.
    - Anticipate continued mechanical ventilation with frequent airflow assessments.
    - Expect brief stay extension.
- Comorbidities and secondary causes[65,66]:
    - Infectious (e.g., pneumonia) or other agents may trigger asthma exacerbation and require additional therapy.
    - Expect brief stay extension.

- Complications due to barotrauma[65–67]:
    - Severe attacks may cause pneumothorax or pneumomediastinum.
    - Anticipate possible chest tube placement.
    - Expect brief to moderate stay extension.
- Slow resolution[65–67]:
    - Severe attacks may result in slow resolution of admission indicators.
    - Anticipate continued intense bronchodilation treatment, flow monitoring, and oxygen as needed.
    - Expect brief stay extension.

12.6 Readmission Risk

Risk of readmission is increased by presence of any of the following[67]:

- Prior asthma hospitalization within last year.
- Patient age 12 to 18 years.
- Complex chronic comorbidity (i.e., chronic illness lasting more than 12 months and involving multiple organ systems or requiring previous hospitalisation).

13 Key Considerations for Patient Preferences

Patient preferences refer to patient perspectives, beliefs, expectations, and goals for health and life, and to the steps employed by individuals in assessing the potential benefits, harms, costs, and limitations of the management options in relation to one another. Patients may have preferences when it comes to defining their problems, identifying the range of management options and selecting or ranking the outcomes used to compare these options.

It is important for healthcare professionals to develop an understanding of the patient as an individual and the unique way in which each person experiences a condition and its impact on their life.

The following recommendations are therefore made for physicians and other healthcare professionals regarding general principles of patient care in Qatar:

- **Respect Patients:** Treat patients with respect, kindness, dignity, courtesy and honesty. Ensure that the environment is conducive to discussion and that the patient's privacy is respected, particularly when discussing sensitive, personal issues. Ask the patient how they wish to be addressed and ensure that their choice is respected and used.

- **Maintain Confidentiality:** Respect the patient's right to confidentiality and avoid disclosing or sharing patients' information without their informed consent. In this context, students and anyone not directly involved in the delivery of care should first be introduced to the patient before starting consultations or meetings, and let the patient decide if they want them to stay.

- **Clarify Third-Party Involvement:** Clarify with the patient at the first point of contact whether and how they like their partner, family members or carers to be involved in key decisions about their care or management and review this regularly. If the patient agrees, share information with their partner, family members or carers.

- **Obtain Informed Consent:** Obtain and document informed consent from patients, in accordance with MOPH policy and guidance.

- **Encourage Shared Decision Making:** Ensure that patients are involved in decision making about their own care, or their dependent's care, and that factors that could impact the patient's participation in their own consultation and care including physical or learning disabilities, sight, speech or hearing impairments and problems with understanding, reading or speaking English are addressed.

- **Disclose Medical Errors:** Disclose errors when they occur and show empathy to patients.

- **Ensure Effective Communication:** Explore ways to improve communication including using pictures, symbols or involving an interpreter or family members. Avoid using medical jargon. Use words the patient will understand and confirm understanding by asking questions.

- **Ensure Continuity of Care:** Provide clear and timely sharing of patient information between healthcare professionals especially at the point of any transitions in care.

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14 Performance Measures

A list of performance measures is given in the table below. Healthcare organisations are encouraged to monitor service performance using the indicator definitions below.

Number	Numerator	Denominator
AC01	Number of patients who have had an asthma review in the preceding 12 months that includes an assessment of asthma control.	All patients aged 8-17 years, with a recorded diagnosis of asthma.
AC02	Number of patients who receive a written personalised action plan.	All patients aged <18 years, with a recorded diagnosis of asthma.
AC03	Number of patients who receive oral or intravenous steroids within 1 hour of presentation.	All patients aged 5-18 years presenting to a healthcare professional with a severe or life-threatening acute exacerbation of asthma
AC04	Number of patients who visited an emergency department in the last year for treatment of asthma.	Number of patients aged 5-17 years, with a recorded diagnosis of asthma.

Table 14.1: Performance Measures.

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Appendix: Detailed Description of the Literature Search

All existing references were evaluated and where necessary and applicable, the latest version of the specific manuscript was used to update the guideline and replace the older reference. The search for clinical practice guidelines on asthma diagnosis and/or management in children, was performed in the *PubMed* database and websites of relevant organisations and societies. The present guideline is primarily based on UK NICE guidelines, Scottish Intercollegiate guidelines, British Thoracic Society guidelines, Global Initiative for Asthma management guideline, Canadian Thoracic Society guidelines, Saudi Thoracic Society guidelines and is supplemented with other relevant studies.

The included publications were identified using the term “asthma” and specified with the following terms in combinations:

guidelines, disease, children, adolescent, prognosis, acute, chronic, upper respiratory tract infection, wheeze, cough, bronchodilators, exacerbation, oxygen saturation, peak expiratory flow rate, control, exercise, preventative therapy, step-wise, classification, spirometry, diagnosis, management, admission, readmission, discharge, chest radiograph, paediatric intensive care unit, treatment, chest tightness, corticosteroids, severity, atopy, fractional inhaled nitric oxide, probability, psychological factor, inhaler technique, inhaler device, vaccine, add-on therapy, length of stay.

Furthermore, to investigate any emerging evidence, the literature has been searched as described in the below mentioned diagram:

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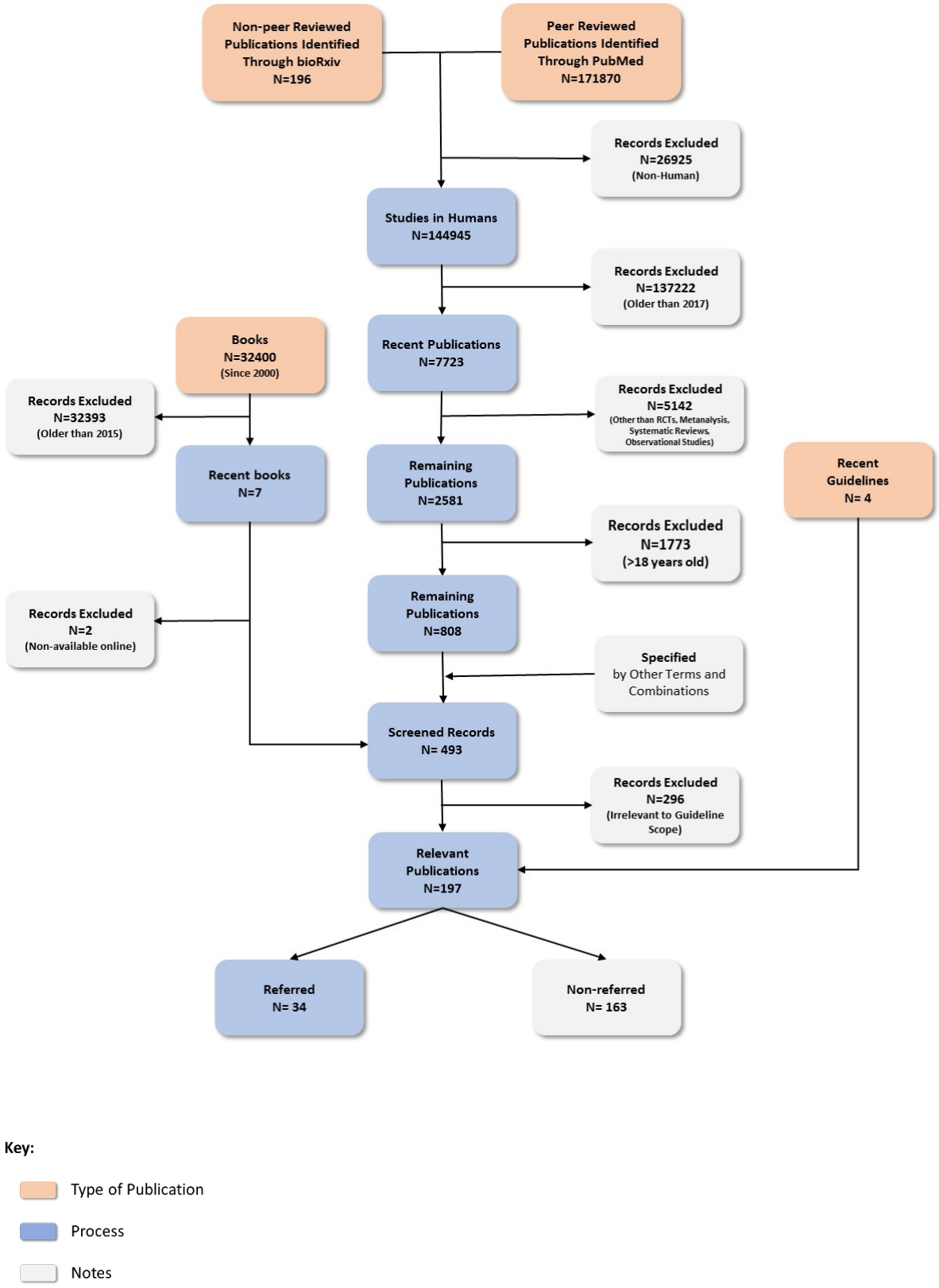

Fig A.1: Literature search results and application of exclusion criteria.

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