Adapting selected international paediatric asthma guidelines for use in Hong Kong

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Asthma is a chronic inflammatory airway disease characterised by variable and recurring symptoms, episodic reversible airflow obstruction, and easily triggered bronchospasm.[1-8] A combination of environmental and genetic factors contributes to its onset. Diagnosis is based on clinical presentation, response to bronchodilators and inhaled corticosteroids (ICS), and spirometric pulmonary function test results.[9] Asthma is classified according to symptom frequency, forced expiratory volume in 1 second (FEV_1), peak expiratory flow (PEF), and atopic versus non-atopic aetiology. Symptoms can be prevented by avoiding triggers and suppressed through the use of ICS.[2,7,8,10]

We previously conducted an extensive review of eight widely accepted and implemented guidelines[11]; however, management approaches vary across these guidelines. These international guidelines provide valuable recommendations for managing childhood asthma, especially in many Asian cities where unified national guidelines are unavailable.[11]

This article offers practical insights into current recommendations for the management of childhood asthma, specifically focusing on diagnosis, severity classification, treatment options, and asthma control. We reviewed the following guidelines from selected countries and organisations in Asia, the United States, the United Kingdom, the European Union, and Australasia:

(1) the Chinese guidelines 2016[12,13];
(2) the Chinese Children's Asthma Action Plan consensus 2020[14,15];
(3) Global Initiative for Asthma (GINA) guidelines 2021[8,16];
(4) the National Asthma Education and Prevention Program and the National Heart, Lung, and Blood Institute (NAEPP-NHLBI) Updates 2020[17];
(5) the European Respiratory Society/American Thoracic Society 2020 guidelines[18];
(6) the United Kingdom's National Institute for Health and Care Excellence (NICE) 2021 guidelines[19];
(7) the joint British Thoracic Society and Scottish Intercollegiate Guidelines Network 2019 guidelines[20];
(8) the European Academy of Allergy and Clinical Immunology Biologicals Guidelines 2020[21]; and
(9) the Australian Asthma Handbook of the Thoracic Society of Australia and New Zealand National Asthma Committee (TSANZ/NAC).[22]

Diagnosis

Many of the reviewed guidelines are similar to the GINA[8,16] and NICE guidelines.[1,5,8,12-22] According to the guidelines, clinical diagnosis of asthma is based on the acquisition of a supporting history, physical examination findings, and the results of relevant investigations. Notably, several guidelines do not rely on the supporting history and physical examination components.[17,18,21]

The guidelines generally agree with some but not all of the clinical and objective approaches to diagnosing childhood asthma described by NICE.[19] According to the GINA guidelines,[8] the utility of fractional exhaled nitric oxide (FeNO) in confirming or ruling out a diagnosis of asthma has not been established.

According to a subset of these major guidelines,[1,5] several conclusions can be drawn. A clinical diagnosis of asthma should be considered in children presenting with recurring or episodic symptoms such as wheezing, breathlessness, cough, and/or chest tightness without an alternative explanation. Spirometry is recommended for all patients with suspected asthma to confirm the diagnosis, assess the severity of airflow limitation, and monitor asthma control. Bronchodilator reversibility can be assessed with a peak flow meter. Importantly, the presence of bronchodilator reversibility is neither diagnostic of asthma nor sufficient to rule it out.[8,16,23] We propose a concise reference of paediatric asthma management for local practitioners (Table).

TABLE. Suggested approach for paediatric asthma management in Hong Kong

Diagnosis Based on clinical history and physical examination ± investigations (eg, spirometry, PEF, and chest X-ray)	
Severity classification Intermittent vs persistent (mild, moderate, severe)	
Treatment Non-pharmacological considerations and pharmacological interventions	
Young children	**Older children/Adolescents**
Intermittent As-needed SABA	**Intermittent** As-needed ICS + SABA or as-needed ICS-LABA (in a single inhaler)
Persistent 1. Daily low-dose ICS + as-needed SABA 2. Medium-dose ICS + as-needed SABA 3. Consider referral to specialist	**Persistent** 1. Daily low-dose ICS-LABA + as-needed ICS-LABA 2. Daily medium-dose ICS-LABA 3. Add-on long-acting muscarinic antagonists 4. Consider referral to specialist
Monitor degree of control eg, Child asthma control test, asthma control test	

Abbreviations: ICS = inhaled corticosteroids; LABA = long-acting beta-2 agonist; PEF = peak expiratory flow; SABA = short-acting beta agonist

Severity

Classification of asthma severity is generally recommended,[1,5,8,12-16,18,20-22] except by the NAEPP-NHLBI[17] and NICE guidelines.[19] Asthma severity is typically classified as mild, moderate, or severe. According to the GINA guidelines,[8] asthma severity is not a static state and may change over time and is currently assessed retrospectively based on the level of treatment required for symptom and exacerbation control. On the other hand, the NHLBI classifies severity as intermittent or persistent and mild, moderate, or severe.[5,24]

Treatment

Treatment comprises both pharmacological and non-pharmacological interventions.[1,5,8,12-22] Pharmacological interventions are similar across guidelines, with specific recommendations for young children and older children/adolescents. Notably, the GINA[8] and the Chinese guidelines[12-14] are similar in this regard. The GINA guidelines[16] recommend short-acting beta agonists (SABAs) as needed for symptom relief across all management steps. Short courses of oral corticosteroids may be necessary for patients presenting with severe uncontrolled asthma. The NAEPP-NHLBI guidelines[5,17,24] also recommend SABAs as needed for symptom relief across all management steps. Stepwise management for asthma differs according to age-group in the joint British Thoracic Society and Scottish Intercollegiate Guidelines Network[20] and the TSANZ/NAC guidelines.[22] Similarly, the NICE guidelines[19] recommend distinct stepwise management for asthma according to age-group.

Treatment for adolescents is outlined in two 'Tracks' within the GINA guidelines.[16] Track 1, using ICS-formoterol for symptom relief, is the preferred approach. Track 2, utilising SABAs for symptom relief, is a recommended alternative if Track 1 is not feasible or preferred by a patient who has not experienced exacerbations with their current therapy.[16] The guideline for children aged 6 to 11 years has been updated to include low-dose budesonide-formoterol for maintenance and relief therapy.[16]

The NAEPP-NHLBI 2020 guideline also includes focused updates.[2,17] Among children aged 0 to 4 years, a short course of daily ICS, rather than as-needed SABAs, is recommended at the onset of a respiratory tract infection.[2,9,17] Among children aged ≥12 years with uncontrolled persistent asthma, the addition of long-acting beta-2 agonist (LABA) to ICS therapy is preferred over the addition of long-acting muscarinic antagonists, as recommended by the Chinese guidelines.[12-14] The use of sublingual immunotherapy for childhood asthma is not generally recommended due to insufficient evidence.[8,9,12-14,19,24]

Inhaled corticosteroids are the preferred controller medication for management of stable asthma. Most of the clinical benefit from ICS therapy is achieved at low to moderate doses. Inhaled corticosteroids should be started at a low to moderate dose (depending on initial symptom severity) and used at the lowest possible effective dose. High-dose ICS use should ideally be avoided to minimise the risks of local and systemic side-effects. Long-acting beta-2 agonist monotherapy should not be used for stable asthma. The addition of LABA to ICS therapy is preferred when symptoms remain uncontrolled despite moderate doses of ICS monotherapy.[11]

Leukotriene modifiers have no role in the management of acute asthma. Monotherapy with leukotriene receptor antagonists (LTRAs) may be an acceptable alternative to ICS for patients with

mild asthma who are unwilling or unable to receive ICS therapy.[8,16] The addition of LTRAs might benefit patients whose asthma remains uncontrolled despite ICS/LABA combination therapy.[8,16,25] Tiotropium may be considered as an add-on treatment if asthma remains uncontrolled on moderate-to-high-dose ICS/LABA combination therapy.[18] Methylxanthine monotherapy is less effective compared to ICS alone.

Short-acting beta agonists are the preferred rescue medications for asthma. Short-acting muscarinic antagonists are less preferred as alternatives or add-ons to SABA for symptom relief. Formoterol monotherapy for relief should be avoided due to safety concerns associated with LABA monotherapy. Oral beta 2 agonists are not recommended for rescue use. It is preferable to consider single-inhaler therapy, incorporating an ICS/LABA combination (formoterol-based) for both maintenance and relief purposes.[11]

Rapid-acting inhaled beta-2 agonists (eg, salbutamol) are the preferred bronchodilators for managing acute exacerbations of asthma. The combination of ipratropium bromide with salbutamol results in better bronchodilation than either medication alone. Ipratropium should be administered to all patients experiencing severe exacerbations of asthma (eg, 500 μg once then 250 μg every 4-6 hours). Metered-dose inhalers with spacers are comparable to nebulisers for managing acute asthma. Nebulisers require higher doses and have greater potential for side-effects. Among patients unable to use a metered-dose inhaler with a spacer, medications can be delivered through a nebuliser. After a patient has been stabilised, they should be switched from a nebuliser to a spacer. Continuous nebulisation (2.5 mg salbutamol every 15 minutes or >4 nebulisations per hour) of rapid-acting SABAs is better than intermittent nebulisation (2.5 mg salbutamol every 20 minutes or ≤3 nebulisations per hour). Subsequent doses of nebulised salbutamol should be 2.5 mg every 2 to 4 hours, depending on the clinical response. Formoterol offers no additional benefit over salbutamol; therefore, it is not recommended for routine use in patients with acute asthma.[11]

Systemic glucocorticoids should be administered to all patients with severe acute asthma. The oral route is as effective as the parenteral route, except in critically ill patients and in patients with contraindications to enteral feeding. For most patients, daily doses of glucocorticoids equivalent to 1 to 2 mg/kg of prednisolone for 5 to 7 days are sufficient. Systemic steroids can be discontinued without tapering if administered for <3 weeks. In cases of non-severe exacerbation, patients should first receive an increased dose of inhaled SABA (4-6 puffs of 100 μg salbutamol every 30 minutes). If there is no response within 1 hour, oral prednisone (1-2 mg/kg) once daily for 5 to 7 days should be initiated. Inhaled corticosteroids do not offer added benefits when combined with systemic corticosteroids and are thus not recommended for acute asthma treatment.[11]

Omalizumab may be considered as adjunct to ICS in patients with moderate to severe asthma, characterised by elevated serum immunoglobulin E (IgE) levels and a positive skin test result for at least one perennial aeroallergen.[26] Single-allergen immunotherapy may provide modest benefits to patients with mild-to-moderate asthma and a skin allergy to that specific antigen. However, multiple-allergen immunotherapy is not currently recommended due to lack of evidence.

The NICE guideline also recommends other therapeutic interventions for asthma management, including oxygen therapy, traditional Chinese medicine, breathing exercises, and vitamin D supplementation.[19] However, there is no consensus among guidelines regarding non-pharmacological management options,[19,21] particularly in terms of prevention/self-management and alternative therapies. Alternative therapies are not generally recommended. Trigger avoidance, patient education, adolescent-to-adult care transition, lifestyle modifications, and asthma action plans are recommended.[19,21]

Monitoring control

Monitoring of asthma control is generally recommended,[1,5,8,12-17,19,20,22] except in the European Respiratory Society/American Thoracic Society 2020[18] and European Academy of Allergy and Clinical Immunology 2020 guidelines.[21] Asthma control should be classified as either adequate or inadequate, considering daytime symptoms (or rescue medication use), nighttime symptoms/awakening, activity limitations, and the results of pulmonary function tests (eg, PEF or FEV_1 value).

Spirometry or PEF variability assessment is generally recommended, but there is no agreement regarding specific thresholds.[8,12-14] According to the GINA guidelines,[8] diurnal PEF variability of >13% in children are considered excessive. If a patient's FEV_1 value falls within the predicted normal range during symptom presentation, it is less likely that those symptoms are attributable to asthma. However, patients with a baseline FEV_1 value >80% of the predicted value can experience clinically significant improvement in lung function with bronchodilator or controller treatment. Predicted normal ranges (especially for PEF) have limitations because no such ranges have been established in children. Therefore, the GINA guidelines recommend using the patient's own best reading as their 'normal' value.[8,12-14]

According to the Chinese guidelines and recommendations, continuous monitoring of

FeNO can help assess asthma control and guide the development of an optimal asthma treatment regimen.[12-15] School-age children are generally able to cooperate with the sputum induction test procedure.[8,12-14] Continuous monitoring of induced sputum eosinophil count may be useful to assess asthma control and guide optimisation of management.[8,12-14]

Asthma management may require adjustments to medication regimens through a control-based cycle approach that involves timely treatment escalation and de-escalation, along with regular monitoring. Treatment escalation is indicated if control is not achieved after reviewing patient adherence, inhaler technique, and trigger control.[19] Treatment de-escalation can be considered when symptoms have been well-controlled for at least 3 months (as per the Chinese,[12-15] NAEPP-NHLBI,[17] and NICE guidelines[19])[5,24] or 6 months (with close supervision within 4-6 weeks as per the TSANZ/NAC guidelines).[22] Asthma control assessment is a key component of asthma care. For children, self-monitoring using an asthma diary is recommended only by the Chinese[12,13] and GINA guidelines.[8,16]

Peak expiratory flow measurements should not be substituted for FEV_1 measurements. Patient self-monitoring of PEF is recommended to facilitate better asthma control. Routine bronchoprovocation testing is not recommended for diagnosing asthma. However, methacholine challenge can be utilised to rule out asthma as a differential diagnosis, particularly when spirometry results are normal. While chest radiographs are not routinely recommended for patients with suspected asthma, they may be considered if an alternative diagnosis or asthma-related complication is suspected.[24]

Quantification of the eosinophil count in sputum (<2% is considered normal while >2% indicates eosinophilic inflammation) can guide ICS therapy, potentially minimising the risk of exacerbations in adults with moderate-to-severe asthma.[24]

Routine measurement of FeNO is not recommended in asthma management. Similarly, routine assessments of allergic status, eg, measurements of total IgE level, measurements of IgE level specific to different environmental allergens, and skin prick tests, are not recommended for diagnosing and managing asthma.[24]

Oxygen saturation should be assessed using pulse oximetry for all patients presenting with an acute asthma attack. Non-severe exacerbations usually do not require additional investigations. Patients with a PEF <60% of predicted or personal best should receive care in the emergency department. Patients with oxygen saturation levels <92% should be managed in the emergency department or hospital ward and should undergo further investigation through arterial blood gas analysis. Oxygen should only be administered to hypoxaemic patients; it should be titrated to maintain oxygen saturation level to stay between 93% and 95%. The absence of pulse oximetry or arterial blood gas data should not preclude oxygen administration. In patients requiring oxygen flow rates >8 L/min, partial pressure of carbon dioxide should be closely monitored.[24]

Pulmonary rehabilitation improves asthma symptoms and quality of life, and significantly improve exercise capacity. Pretreatment with bronchodilator agents (SABAs, short-acting muscarinic antagonists, and LABAs), as well as anti-inflammatory agents (LTRAs but not ICS), is effective in attenuating the reduction of FEV_1 associated with exercise-induced asthma.[8,16,27] Regular use of ICS or LTRAs is effective in preventing exercise-induced asthma.[27]

Smoking cessation should be recommended for all asthma patients who smoke. Optimal self-management of asthma, involving patient education, self-monitoring, regular physician review, and a written asthma action plan, is recommended.

Conclusion

Despite the recent comprehensive update of the GINA guidelines in 2023,[28,29] it remains impractical to fully adhere to these guidelines or any other single set of guidelines in both public and private paediatric healthcare settings within Hong Kong due to multiple pragmatic issues.

Asthma is a heterogeneous syndrome encompassing many underlying causes and patient characteristics, along with varying degrees of mucus hypersecretion, airway hyperreactivity, and inflammation.[30] A severity classification should be established to guide treatment. Current clinical management aims for disease control, including symptom control, risk reduction, and prevention of severe exacerbations. A personalised treatment strategy, with inhaler therapy as the core, which titrates airway inflammation and bronchodilation therapies according to symptoms and objective asthma assessments, should benefit most patients with asthma. It can be difficult, if not impossible, for general practitioners and paediatricians to follow these guidelines due to various constraints, including the availability of diagnostic tools, the need to incorporate patient preferences, and the frequency of guideline updates. For example, the latest update to the GINA 2024 report was published on 22 May 2024 to clarify some medication doses.[31] The maintenance and as-needed use of ICS-formoterol, as proposed by the GINA[8,16,31] and NICE guidelines,[19] offers a simple, flexible, and safe treatment option for patients with asthma and clinicians. Short-acting beta agonists with or without ICS remain the

preferred treatment for young children. However, inhaler therapy adherence, steroid phobia, and mistrust of Western medicine remain important health issues for patients with asthma and their families.[32]

Guidelines should not be rigidly followed; factors such as resources, family attitudes, and compliance must be considered. In-depth counselling and the establishment of good rapport are key components to successful management of this prevalent and challenging disease in Hong Kong.

Author contributions

All authors contributed to the concept or design, acquisition of the data, analysis or interpretation of the data, drafting of the manuscript, and critical revision of the manuscript for important intellectual content. All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

Conflicts of interest

As an editor of the journal, KL Hon was not involved in the peer review process. Other authors have disclosed no conflicts of interest.

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