COMMENTARY

Primary Care Management of Asthma Exacerbations or Attacks: Impact of the COVID-19 Pandemic

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ABSTRACT

The COVID-19 pandemic has brought a renewed focus on appropriate management of chronic respiratory conditions with a heightened awareness of respiratory symptoms and the requirement for differential diagnosis between an asthma attack and COVID-19 infection. Despite early concerns in the pandemic, most studies suggest that well-managed asthma is not a risk factor for more severe COVID-related outcomes, and that asthma may even have a protective effect. Advice on the treatment of asthma and asthma attacks has remained unchanged. This article describes some challenges faced in primary care asthma management in adults and in teenagers, particularly their relevance during a pandemic, and provides practical advice on asthma attack recognition, classification, treatment and continuity of care. Acute attacks, characterised by increased symptoms and reduced lung function, are often referred to as exacerbations of asthma by doctors and nurses but are usually described by patients as asthma attacks. They carry a significant and underestimated morbidity and mortality burden. Many patients experiencing an asthma attack are assessed in primary care for treatment and continuing management. This may require remote assessment by telephone and home monitoring devices, where available, during a pandemic. Differentiation between an asthma attack and a COVID-19 infection requires a structured clinical assessment, taking account of previous medical and family history. Early separation into mild, moderate, severe or life-threatening attacks is helpful for continuing good management. Most attacks can be managed in primary care but when severe or unresponsive to initial treatment, the patient should be appropriately managed until transfer to an acute care facility can be arranged. Good quality care is important to prevent further attacks and must include a follow-up appointment in

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primary care, proactive regular dosing with daily controller therapy and an understanding of a patient's beliefs and perceptions about asthma to maximise future self-management.

Keywords: Asthma; Attacks; Exacerbations; Management; Pandemic; Primary care

Key Summary Points

During pandemics caused by respiratory viruses, such as in COVID-19, it is even more important, where possible, to prevent asthma attacks and to intervene and manage appropriately when they occur.

The advice on managing attacks remains unchanged.

Asthma attacks represent an increase in patients' symptoms and a reduction in lung function which may lead to an increased use of reliever medication, highlighting a need for inhaler technique assessment, a treatment compliance check and appropriate asthma treatment together with a written asthma action plan.

Most asthma attacks are mild or moderate and can be managed entirely in primary care, but this depends on prompt recognition and classification of attack severity, whether face to face or remotely.

Whether an asthma attack is managed in primary care or in an acute care setting, every patient should be prescribed regular asthma controller therapy and have a follow-up visit in primary care soon after, certainly within 2 weeks, to assess response and to establish regular maintenance treatment to prevent further problems with asthma.

INTRODUCTION

At the outset of the COVID-19 pandemic, there were concerns about its impact on patients with asthma and other chronic respiratory conditions [1], both in terms of its effect in triggering acute exacerbations or attacks, and as a risk factor for more severe disease and death [2]. As the pandemic continued, several studies showed a reduction in asthma attacks reported in primary care and in emergency departments [3–7], possibly related to social distancing, the wearing of face masks, less air pollution, and improved self-management [5, 8, 9], rather than pandemic-related healthcare avoidance [7]. In addition, reports from many countries have suggested that well-managed asthma is not a risk factor for more severe outcomes [2, 10], and that asthma may offer some protection against the detrimental effects of COVID-19 infection [2, 11]. Throughout the pandemic, asthma management guidelines have reinforced the importance of continuing treatment to maintain asthma control and reduce the risk of future attacks [12–14]. The advice on managing asthma attacks remains unchanged.

Asthma attacks are acute asthma episodes that comprise an increase in symptoms and a reduction in lung function needing increased reliever medication use, and perhaps a change in controller treatment [15]. They are also referred to as asthma exacerbations or flare-ups; however, a 2018 *Lancet* commission called for the term asthma attack to replace these terms in recognition of their importance as markers of a high risk of future attacks and even death, rather than mild episodes of inconvenience [16]. The term attack is also preferred by patients as it describes how they feel and is better understood by their friends and family [17]. For these reasons, we use the term attack in this article.

Asthma attacks are a major health burden to patients and a financial and staff burden to public health services [15]. They usually occur in those with an existing diagnosis of asthma but may be the first signs a patient seeks healthcare support [15]. Although greater

asthma severity is associated with more attacks [18], all with asthma, irrespective of its severity, are at risk [18–21]. An asthma attack is a significant predictor of future events [18, 22–24]. The severe attack rate (i.e. those requiring treatment with oral corticosteroids (OCS), an emergency department visit or hospitalisation) has been reported in epidemiological surveys as 0.1–0.2 per patient per year, with most treated with OCS only [18, 25]. Although it is uncommon that patients with asthma have asthma-related hospitalisations or die (less than 1%) [26], prompt diagnosis of an attack with determination of its severity is important, as delay can be fatal [27].

In most countries, primary care is the first place of contact [28, 29]. Primary care physicians (PCPs) deal with many other asthma challenges, including access to asthma medicines, spacer device availability, patient adherence to treatment regimens, implementation of a written asthma action plan, difficult access to care in rural areas and the demand of patients' everyday work and life [29–32]. Many asthma-related deaths can be prevented by better education, use of asthma action plans, more accurate and timely diagnosis, rapid referral to a respiratory specialist when needed, better follow-up, and encouragement to continue taking regular preventative medicines [33, 34]. PCPs have faced additional challenges in the COVID-19 pandemic, not only in the differential diagnosis between asthma attacks and COVID-19 infections but also in assessing the severity of an attack and asthma control via remote consultation to ensure the appropriate acute treatment and future care [35].

This article describes the challenges faced in primary care in managing asthma attacks in adults and teenagers, their relevance during a pandemic and offers practical advice about attack recognition, classification, treatment and continuing care (Fig. 1).

This article is based on previously conducted studies and does not contain new clinical studies involving human participants or animal studies by any of the authors.

WHAT ARE THE KEY INDICATORS FOR RECOGNISING AN ASTHMA ATTACK AND WHAT IS THE DIFFERENCE BETWEEN AN ASTHMA ATTACK AND A COVID-19 INFECTION?

Acute asthma attacks are characterised by a progressive increase in symptoms of breathlessness, cough, wheezing and/or chest tightness, plus a fall in lung function [15]. For differentiation between an attack and a COVID-19 infection, a structured clinical assessment is recommended, involving a detailed history and review of the patient's clinical records including review of any investigations such as recent peak expiratory flow rate (PEFR), spirometry or blood eosinophil findings [35, 36]. Whilst both may present with cough and breathlessness, patients experiencing an attack usually present with wheeze, a reduced PEFR and demonstrate symptoms which improve following use of a reliever inhaler [12, 13, 35]. A personal or family history of asthma is another criterion for a higher probability of asthma [36]. COVID-19 infection is more likely to be signalled by a high body temperature, a dry hacking continual cough, flu-like symptoms (fatigue, headache), loss of taste/smell, and symptoms unresponsive to the use of reliever treatment [12, 13, 35]. In many, differential diagnosis may be possible without PEFR and spirometry, which is preferable because of the potential transmission of viral infections [36]. As new variants of COVID-19 emerge, differences may become less distinct.

It is helpful to bear in mind that the most common trigger of an asthma attack is a viral respiratory infection or allergen exposure, both of which are subject to seasonal variation [15, 37, 38]. Pollutants (tobacco smoke, outdoor and indoor air pollutants) may also trigger an attack. Attacks are heterogeneous in their time course and severity, making them challenging to recognise and treat in primary care [39]. Several studies have shown variations in reliever use before and during the time course of an asthma attack [40–42], and such patterns can
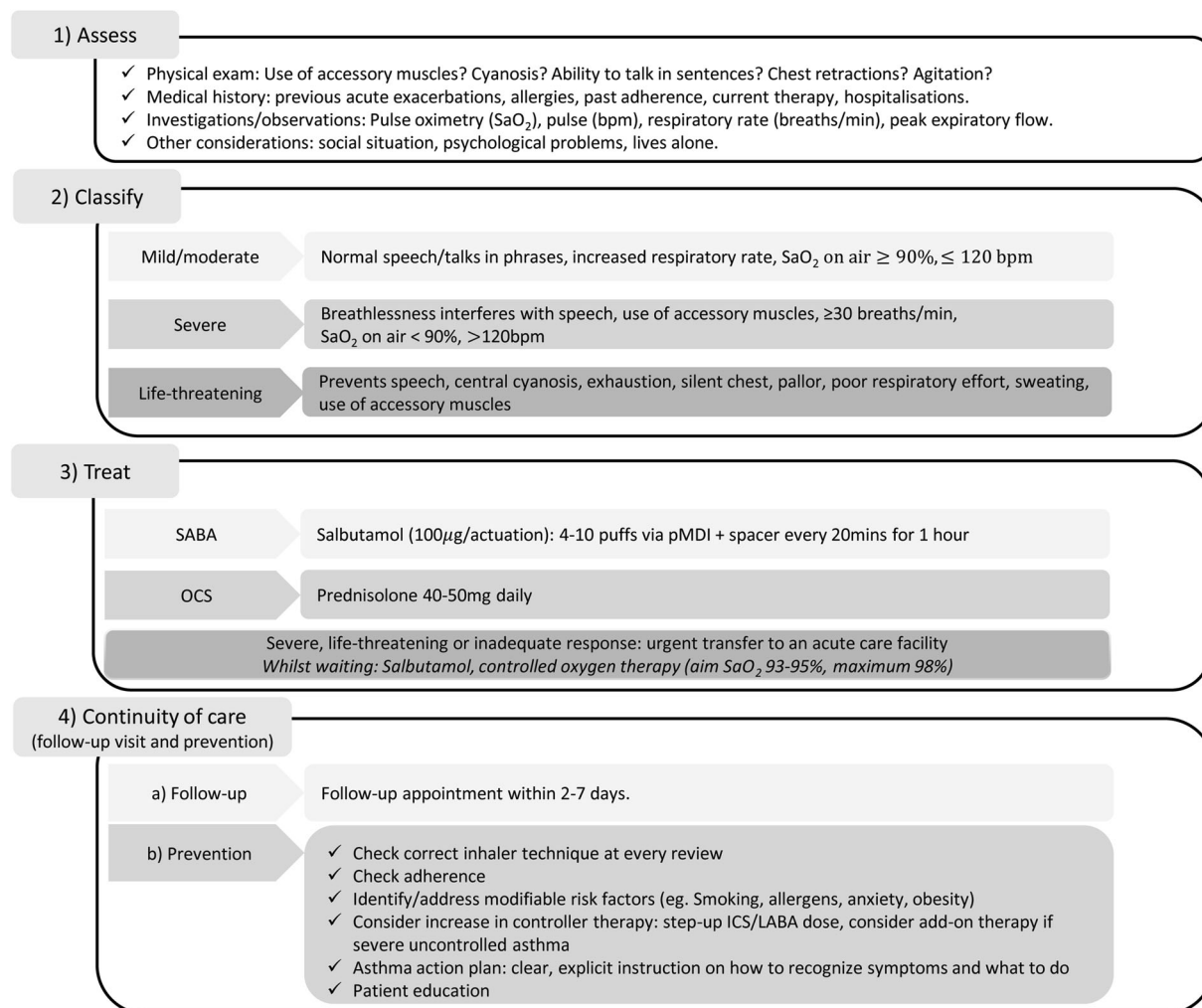
1) Assess
- ✓ Physical exam: Use of accessory muscles? Cyanosis? Ability to talk in sentences? Chest retractions? Agitation?
- ✓ Medical history: previous acute exacerbations, allergies, past adherence, current therapy, hospitalisations.
- ✓ Investigations/observations: Pulse oximetry (SaO$_2$), pulse (bpm), respiratory rate (breaths/min), peak expiratory flow.
- ✓ Other considerations: social situation, psychological problems, lives alone.

2) Classify

Mild/moderate	Normal speech/talks in phrases, increased respiratory rate, SaO$_2$ on air $\geq$ 90%, $\leq$ 120 bpm
Severe	Breathlessness interferes with speech, use of accessory muscles, $\geq$30 breaths/min, SaO$_2$ on air < 90%, >120bpm
Life-threatening	Prevents speech, central cyanosis, exhaustion, silent chest, pallor, poor respiratory effort, sweating, use of accessory muscles

3) Treat

SABA	Salbutamol (100μg/actuation): 4-10 puffs via pMDI + spacer every 20mins for 1 hour
OCS	Prednisolone 40-50mg daily
	Severe, life-threatening or inadequate response: urgent transfer to an acute care facility *Whilst waiting: Salbutamol, controlled oxygen therapy (aim SaO$_2$ 93-95%, maximum 98%)*

4) Continuity of care
(follow-up visit and prevention)

| a) Follow-up | Follow-up appointment within 2-7 days. |
| b) Prevention | ✓ Check correct inhaler technique at every review
✓ Check adherence
✓ Identify/address modifiable risk factors (eg. Smoking, allergens, anxiety, obesity)
✓ Consider increase in controller therapy: step-up ICS/LABA dose, consider add-on therapy if severe uncontrolled asthma
✓ Asthma action plan: clear, explicit instruction on how to recognize symptoms and what to do
✓ Patient education |

Fig. 1 Overview of the management of acute attacks of asthma in primary care. *bpm* beats per minute, *ICS* inhaled corticosteroid, *LABA* long-acting β$_2$-agonist, *OCS* oral corticosteroid, *pMDI* pressurised metered-dose inhaler, *SaO$_2$* saturated oxygen, *SABA* short-acting β$_2$-agonist

serve as a helpful indicator of an impending attack and its subsequent control.

WHAT ARE THE CLINICAL SIGNS AND SYMPTOMS FOR CLASSIFYING THE SEVERITY OF AN ASTHMA ATTACK DURING A PANDEMIC?

Appropriate management depends on the asthma attack severity so it is important to immediately assess how severe it really is (Table 1) [15, 27, 43, 44] and where best to manage it (Fig. 2).

Under conditions of normal clinical practice, a full clinical history and a careful physical examination are required to assess heart rate, the use of accessory muscles, any chest wall retraction, wheezing, level of breathlessness, respiratory rate, cyanosis of lips and tongue, any agitation or reduced consciousness. Also measurement of lung function (PEFR or forced expiratory volume in 1 s (FEV$_1$)) are helpful to define an attack as mild, moderate, severe, or life-threatening (Table 1) [15, 27, 43, 44]. Objective measures of lung function are more reliable indicators of attack severity than symptoms [15, 44]. Pulse oximetry, if available,

Table 1 Asthma attack severity classification in adults and young people ($\geq$ 12 years of age) [15, 27, 43, 44]

Clinical signs/ symptoms	Severity of attack			
	Mild	Moderate	Severe	Life-threatening
Breathlessness	On activity/exertional	Interferes with or limits normal activity	At rest or interferes with speech	Prevents speech
Speech	Normal speech	Speech in phrases	Unable to complete sentences	Unable to speak
Extrapulmonary symptoms/Alertness	Usually not agitated	Maybe agitated	Possible cyanosis of the lips Agitation, nasal flaring, sweating	Central cyanosis Drowsy, exhaustion, pallor, sweating
Suprasternal restrictions; use of accessory muscles	Usually no suprasternal retractions or use of accessory muscles	Commonly suprasternal retractions, possible use of accessory muscles	Usually suprasternal retractions and use of accessory muscles	Paradoxical thoraco-abdominal movement, use of accessory muscles
Respiratory rate	Increased	Increased	$\geq$30/min	Poor respiratory effort/silent chest
Heart rate (bpm)	<110	110-120	>120	Arrhythmia
Oxygen saturation (on air)	$\geq$90%	$\geq$90%	<90%	<90%
PEF (percentage of predicted)	$\geq$50%	$\geq$40-50%	<40-50%	<33%

bpm beats per minute, *PEF* peak expiratory flow, *SaO₂* oxygen saturation, *y* years

is also helpful to determine severity and has prognostic value [15].

During the COVID-19 pandemic the recommendations in Table 1 and Fig. 2 are suggested using a combination of patient self-assessment tools such as PEFR monitoring where available, an asthma action plan and ehealth strategies personalised for patients with asthma. This means leveraging the use of home monitoring devices assessing heart rate, breathing rate and oxygen saturation, handheld spirometers, and smart devices assessing adherence, and inhalation technique [35, 36, 45, 46].

Remote clinical assessment, so often required during the COVID-19 pandemic, relies on a telephone call consultation, preferably augmented by a video link [35]. Some patients may still require face-to-face consultation. Patients' key signs and symptoms should be determined in the context of their wider clinical history and through questioning them about their symptoms in relation to their normal health status such as their usual breathlessness and respiratory rate [35, 36, 47]. Try to establish any risk factors for asthma-related death (a history of near-fatal asthma, excessive use of reliever treatment (more than one cannister per

month), not using or poor adherence to inhaled corticosteroid (ICS) preventative treatment, recent or current use of OCS, a recent emergency hospital visit or admission with asthma, a history of psychiatric disease or psychosocial problems, food allergy, comorbidities, including obesity and cardiovascular disease [15, 27, 44]). Patient medical records should also be checked for risk factors of poor outcome with COVID-19 infection. Patients who struggle to complete sentences, have a respiratory rate of 25 breaths/min or higher, a PEFR less than 50% of predicted or a heart rate of 120 bpm or higher, all suggest a severe attack, needing prompt transfer to an acute care facility (Table 1; Fig. 2) [15, 27, 43, 44].

Self-assessment by patients to monitor their asthma using both objective and subjective measures is a pragmatic approach. The assessment of asthma control at home using asthma control questionnaires (e.g. Asthma Control Test or Asthma Control Questionnaire) provides one tool of assessment [35, 36]. Remote monitoring through patients recording their daily PEFR readings, if available, and/or the presence of any asthma symptoms in a daily diary, may also help observe a cause-and-effect relationship
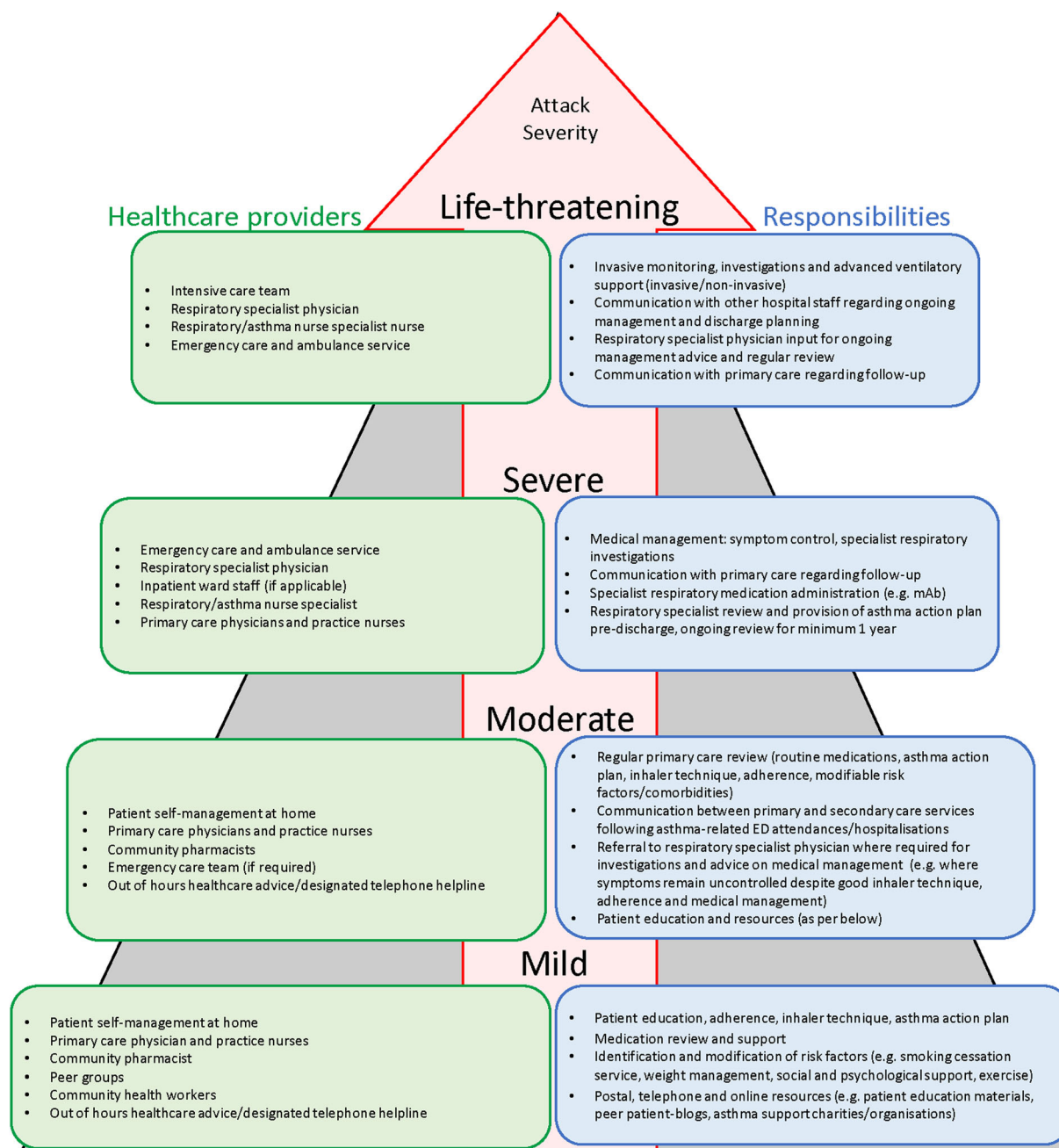
Fig. 2 Stepwise healthcare provider model for acute attacks [15, 27, 94]. *ED* emergency department, *mAb* monoclonal antibody

between exposure to triggers and decrements in peak flow and/or exacerbations of asthma and to give early warning signs of a potential deterioration, for both PCPs and patients via their written action plan (Fig. S1, Supplementary Material). However, patients may be reluctant to continue this for a substantial length of time.

HOW CAN ASTHMA ATTACKS BE MANAGED EFFECTIVELY IN PRIMARY CARE DURING A PANDEMIC?

The advice on managing asthma remains unchanged during the COVID-19 pandemic [12, 13, 48]. A shortage of asthma inhalers was observed during the pandemic; the shortage of short-acting β2-agonist (SABA) inhalers reinforced the importance and well-established role of SABA in the current management of asthma [49]. For most patients with asthma, the risk of inadequately treating an asthma attack is worse than the risk from COVID-19 infection [12].

Most attacks are classified as mild or moderate and can be entirely managed in primary care. Severe or life-threatening attacks usually require treatment in an acute care facility

(Fig. 3) [15]. A comparative overview of treatment recommendations in primary care versus acute care is shown in Table S1 (Supplementary Material). There are some differences in recommendations across guidelines.

Mild and Moderate Asthma Attacks

All patients need immediate treatment with inhaled SABA, usually salbutamol/albuterol, together with the prompt introduction of orally administered prednisolone [15, 27, 43, 44]. Hypoxaemia requires supplemental oxygen. Patients should be closely observed and treatment adjusted according to response.

Inhaled SABAs have a rapid onset of action (less than 5 min), are well tolerated, and repeated administration achieves incremental bronchodilatation [43]. In adults and young
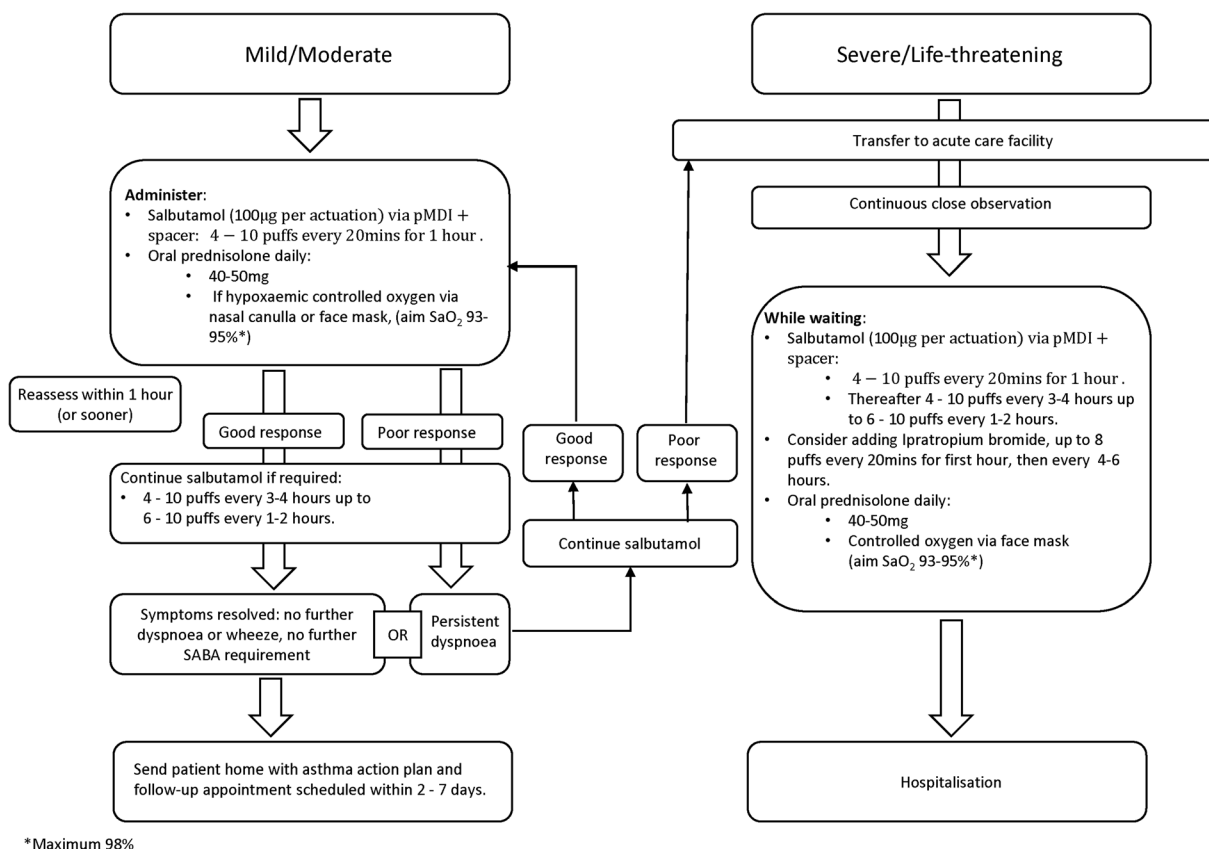
Fig. 3 Treatment of acute attacks of asthma in adults/young people (> 12 years of age). *pMDI* pressurised metered-dose inhaler, *SABA* short-acting β2-agonist, *SaO₂* saturated oxygen

people, the recommended dose is 4–10 puffs of inhaled SABA via a pressurised metered-dose inhaler (pMDI) plus a spacer (preferably a larger volume spacer, 750 mL) every 20 min for 1 h [15]. If symptoms rapidly resolve, no further SABA treatment may be needed; consider sending the patient home with appropriate controller therapy, an asthma management plan and a follow-up appointment [15]. Doubling the dose of ICS has been shown to improve asthma outcomes in self-management studies [50], although this strategy is not well supported by results of placebo-controlled trials [15, 51, 52]. It is hypothesised that in real life, patients may at this point be reintroducing the inhaled steroids as originally prescribed rather than actually doubling their medication—hence the incongruence.

OCS treat the underlying inflammation but take up to 4 h to show clinical benefit; therefore, they should be commenced as soon as possible (i.e. at the same time as initial SABA treatment). A dose of orally administered prednisolone 40–50 mg once daily is an accepted dose for teenagers and adults for 5–7 days [15, 27]. To prevent an upset stomach, they should be taken with food, not on an empty stomach [53, 54].

In the absence of pulse oximetry, if the patient appears cyanosed and/or distressed, oxygen should be given through nasal cannulae or using a face mask. Observe the patient closely for deterioration, drowsiness or fatigue [15, 27, 43, 44]. If oximetry is available and oxygen saturations are below 94%, supplemental oxygen should be given to maintain saturations of 93–95% [15, 43], with a maximum of 98% [27]. Excessive oxygenation can be harmful and may increase the risk of hypercapnia [15, 27, 43, 55]. Where supplemental oxygen is not available, monitor the patient very closely, transferring as soon as possible to an acute care facility.

Reassess all patients after 1 h (sometimes sooner) [15]. If the response to initial SABA is suboptimal give further doses as needed (4–10 puffs every 3–4 h or even every 1–2 h if the clinical situation demands it) [15]. If symptoms fully resolve, consider sending the patient home with an asthma management plan, preventative and relief therapy together with a follow-up appointment date. Should symptoms fail to improve, or if the response to initial SABA administration is poor [56], start treatment as for a severe attack as described in the next section and arrange urgent transfer to an acute care setting [15]. Close observation is essential [44].

Severe or Life-Threatening Asthma Attacks

These patients need urgent transfer to an acute care facility preferably by ambulance [15]. Drowsiness, confusion, collapse, cyanosis, a silent chest, altered consciousness or oxygen saturations below 90% represent potentially life-threatening situations [15, 43]. Whilst awaiting transfer, patients should remain under the direct supervision of a healthcare professional within the primary care facility and be continuously monitored for signs of hypoxaemia, worsening conscious levels, fatigue and/or somnolence [15, 43]. Give salbutamol up to 10 puffs via a pMDI plus spacer every 20 min up to 1 h then up to 10 puffs every 1–2 or 3–4 h. Consider adding ipratropium bromide 8 puffs (every 20 min in the first hour and every 4–6 h subsequently) [15, 43, 44]. Patients with moderate to severe asthma attacks who were receiving both salbutamol and ipratropium bromide were at lower risk of needing hospital admission than those on salbutamol alone [57]. They did, however. experience more side effects. Give OCS as described in the previous section, and continue supplemental oxygen and SABA until transport arrives [27].

The aforementioned guidance is summarised in the algorithm for the treatment of acute attacks (Fig. 3).

Antibiotic Therapy

The use of antibiotics in the management of acute asthma is not recommended, unless there is strong evidence of a bacterial infection [15, 58]. Most infections initiating an attack are likely to be viral in origin [27].

Device Choice for Managing Attacks

A nebuliser and pMDI plus large volume spacer are both options for SABA treatment [15, 27]. Spacers reduce the requirement for patients to coordinate actuation and inhalation, thereby improving delivery of medicines into the airways where they are needed [59]. During acute attacks a pMDI and spacer is the preferred route of SABA delivery, and the most cost-effective [15, 60]. While nebulisers are generally not recommended especially for inhaled steroids and in the current pandemic situation [12–14], they may be helpful in those who have life-threatening asthma or who are agitated, distressed or finding difficulty in using a pMDI and spacer [44], and should be administered with appropriate care [61, 62].

CONTINUITY OF CARE

The advice on patient continuity of care following an asthma attack remains unchanged [12] with requirement for a clear follow-up and review pathway in place, as described in the next section. Patients with asthma should be advised to look out for any worsening symptoms with clear advice on what to do and, with the potential for long waits for remote assessment, patients should be advised to have a low threshold to call the emergency services, in cases where symptoms deteriorate [35].

Follow-Up Appointment

A follow-up appointment in primary care, whether face to face or by remote monitoring, is an important next step for preventing future asthma attacks, both for attacks managed fully in primary care and those managed in acute care settings (Fig. 4) [15]. Following discharge from an acute care facility, a significant proportion of patients with asthma relapse within 4 weeks [63], highlighting the importance of an early follow-up in primary care to ensure that adequate, regular preventative therapy has been prescribed and is being taken. Depending on the asthma severity and the patient's social

circumstances, all patients should have a primary care follow-up appointment soon after an attack, preferably within 2–7 days but certainly within 2 weeks [15, 27].

At follow-up, it is important to establish the risk factors that led to the attack and the risk factors for further asthma attacks [15, 27]. Comorbidities such as rhinitis are common and need managing [15, 64, 65]. Discussions should check that resources at home are adequate, including access to medications/spacer device, medication affordability and parent/carer awareness [15, 31, 65]. In low- and middle-income countries, patient affordability is a key consideration that influences treatment choice [65]. Inhaler technique and the patient's asthma action plan should also be reviewed [15, 27]. Subsequent reviews should be scheduled to assess the effectiveness of medication, and when asthma is well controlled, the frequency of reviews can be reduced [15]. These reviews could be either face to face or via social media platforms, the latter as used during the COVID-19 pandemic.

Overcoming the barriers to managing acute asthma attacks in primary care is essential to effectively treat existing symptoms, achieve long-term asthma control and help prevent future episodes. Every follow-up encounter should be viewed as an opportunity to review and extend patient knowledge and confidence with asthma management [27]. In addition to optimised controller medication, provision of patient education and an asthma action plan are integral components of effective follow-up [66].

Figure 5 provides an overview of the potential barriers to the management of acute attacks of asthma in primary care and summarises associated mitigating actions.

Prevention of Future Asthma Attacks

Inhaler Technique
Many patients with asthma are unable to use their inhaler correctly [67, 68]. Common errors in the use of inhalers include exhalation during actuation, lack of hand–breath coordination, breath-hold too short, inspiratory flow too
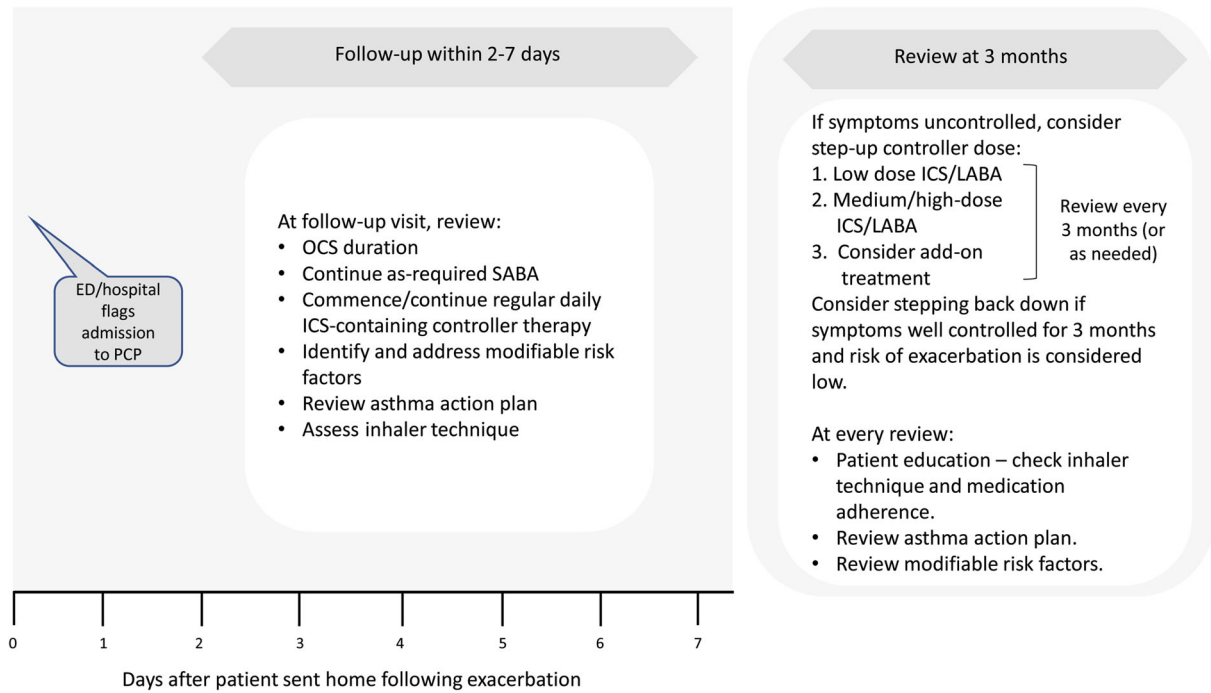
Fig. 4 Primary care follow-up after an acute attack of asthma [15]. *ED* emergency department, *GP* general practitioner, *ICS* inhaled corticosteroid, *LABA* long-acting β₂-agonist, *OCS* oral corticosteroid, *SABA* short-acting β₂-agonist
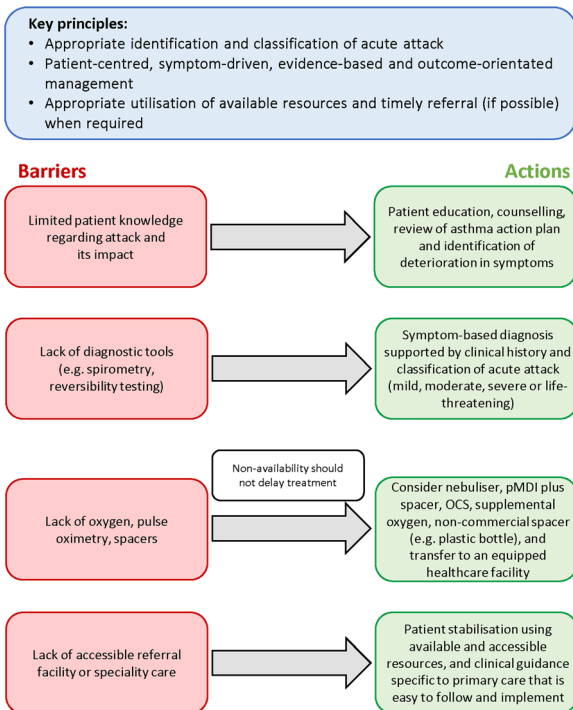

Fig. 5 Overcoming barriers to the management of acute asthma in primary care. *OCS* oral corticosteroid, *pMDI* pressurised metered-dose inhaler

rapid, and inadequate shaking of inhaler [67]. It is a good idea to check a patient's inhaler technique regularly, particularly following an asthma attack, and to determine causes of poor technique. Assessing inhaler technique remotely is challenging but can and should be done [45, 46].

A review of inhaler technique critical errors indicated that 50% of patients with asthma fail to maintain correct inhaler technique over time and highlighted the importance of patient psychosocial factors for maintaining good inhaler skills [69]. In a qualitative, questionnaire-based study, Jahedi et al. reported that patients intrinsically linked inhalation device use, selection, and preference to medication effectiveness, overall views about asthma management, and belief and trust that their healthcare providers could make decisions about their medications for them [68]. Therefore, emphasizing that the correct inhalation technique can lead to better asthma control and fewer side effects may provide motivation for patients to learn and maintain a good inhaler technique [68].

Referral to an appropriately trained asthma nurse or pharmacist for education can be helpful [15]. Some patients may also benefit from the use of approved and reputable web-based inhaler training videos to supplement this [70].

Medications to Control Asthma

All patients who have had an asthma attack should be prescribed regular daily ICS-containing controller therapy [15], which should be started early to avoid the risk of repeated attacks [71]. Proactive regular dosing with ICS-containing therapies achieves symptom control and reduces attacks [15, 72], both of which should be targeted for effective management of asthma [15, 27, 43]. In patients who are adherent and using their inhalers correctly, if symptoms remain uncontrolled after an attack, and/or the patient is at high risk of a future attack, treatment may be stepped up to a fixed-dose combination of ICS with a long-acting beta-agonist (LABA), plus 'as-required' use of SABA as a reliever [15]. Regular daily dosing with combined ICS and LABA is most effective in preventing severe attacks of asthma compared with other controller therapies, including ICS alone [73, 74]. The AUSTRI study, a large randomised controlled trial of patients with a history of asthma attacks ($N = 11{,}751$), demonstrated a 21% reduced risk of a severe attack with fluticasone propionate combined with salmeterol compared with fluticasone propionate alone [74].

In patients receiving regular maintenance therapy with either ICS or ICS-LABA plus SABA as a reliever, patterns of increased SABA use can serve as an indicator of an impending attack and should be heeded as a marker of uncontrolled asthma [75, 76]. This should prompt patient evaluation by the physician and, if appropriate, changes to their treatment including close follow-up and reinforcing the use of an asthma action plan. In a database cohort study analysis, Nwaru et al. reported that, despite the increased risks associated with long-term high SABA use, these patterns of SABA use did not trigger any increases in maintenance ICS therapy, highlighting the need for paying closer attention to these patients to establish asthma control [76].

Adherence to Treatment

Many patients with asthma fail to take their medicines at least some of the time [77], with mean levels of adherence reported as ranging between 22% and 70% [78–83]. Factors contributing to poor adherence include a perceived burdensome medication regimen, cost, forgetfulness, poor health literacy, side effects, cultural issues or psychosocial factors [77, 84]. Poor adherence to controller treatment is a risk factor for poor asthma outcomes including increased risk of asthma attacks [85–87]. A simple message for patients is that taking their regular controller medications as recommended is a good way to avoid attacks.

A lack of adherence may be intentional or non-intentional and establishing the rationale of non-adherence will help to find solutions to improve it [81]. Methods to encourage better adherence include simplifying treatment regimes, reducing the frequency of dosing, providing advice on medication reminders, and including patients in treatment decisions [15]. An understanding of a patient's perceptions about their asthma may also help to identify and address their reasons for poor adherence [80]. The use of smart devices, where available, may also provide a useful tool for assessing adherence remotely [45, 46].

Asthma Action Plan

Patient-led written asthma action plans have been recommended for many years [15, 50], with the aim of reducing the likelihood of future attacks and of dying from asthma. They have been shown to improve health outcomes including fewer emergency department visits and hospitalisations [50]. An effective asthma action plan advises patients what to do in the event of worsening asthma symptoms, how to make short-term adjustments to their regular medications to manage their condition and provides clear instructions on how and when to access medical care [15, 88]. Primary care physicians should bear in mind the available healthcare resources, patient literacy levels and cultural factors [15]. Figure S1 (Supplementary Material) provides an effective example of an asthma action plan, which has been developed by Asthma UK [88].

Patient Training and Education

Patient education forms the basis for encouraging good adherence and effective self-management of asthma [80]. Patient understanding of the purpose of adherence to medication, follow-up appointments and correct inhaler technique should be reviewed and its importance reiterated [15, 43]. The value of educational interventions has been demonstrated in terms of both improved adherence and asthma outcomes [80]. Asthma attacks can represent a failure in management due to poor health literacy [43]; therefore, educational materials should be formatted and tailored to the needs of individual patients [80].

Patient education should also include a patient-centred discussion around minimising environmental attack triggers, cigarette smoke and avoidance of allergens [27, 89, 90].

WHAT HAS BEEN THE IMPACT OF COVID-19 ON ASTHMA ATTACKS AND WHAT ARE THE LEARNINGS FROM COVID-19?

During the COVID-19 pandemic, significant reductions in severe asthma attacks have been reported, in both primary care [3] and in those needing hospital admission [5, 6]. The reasons for this are not totally understood but could be multifactorial and may include a decrease in air pollution, due to the reduction in the use of cars, a decrease in the circulation of respiratory viruses associated with distancing measures and wearing of masks, and improved self-management including increased adherence to preventative medications [8, 9, 14]. Understanding the reasons for such reductions could provide future learnings for managing patients with asthma [8]. Chalitsios et al. reported an increase in ICS prescriptions at the outbreak of the pandemic in the UK, with a decrease to baseline levels over the following months [91]. Analysis of digitally collected adherence data, based on electronic monitoring, demonstrated a 14.5% increase in adherence to controller medications during the first few months of the pandemic [9]. This suggests an increased recognition of asthma as a comorbidity and a heightened awareness of the importance of the disease. Understanding patients' perceptions and concerns during this period could provide an opportunity to improve patient self-management and reduce avoidable attacks [8].

Several recent publications have highlighted that asthma outcomes, including mortality, are not worsened by COVID-19 infection, even suggesting some protective effects. In a systematic literature review of 62 studies, Hou et al. reported that asthma was associated with a reduced risk of COVID-19 mortality [11]. The mechanism for this is unclear but the authors suggested that it could be related to an increase in medical care received by patients with asthma and COVID-19 infection, or due to an anti-inflammatory protective effect associated with the type 2 immune response in patients with asthma or possibly from their treatment with ICS. Lombardi et al. also suggested that downregulation of angiotensin-converting enzyme 2 (ACE2) receptors, as well as chronic type 2 inflammation, younger age, absence of comorbidities and reduced viral exposure due to shielding in patients with asthma might be possible mechanisms by which asthma protects against COVID-19 infection and poor outcomes [2]. Another review and meta-analysis of 57 studies reported that patients with asthma have a lower risk of acquiring COVID-19, a possible explanation being the downregulation of ACE2 receptors observed in type 2-high asthma and with ICS treatment [92]. Asthmatics with confirmed COVID-19 based on positive reverse transcriptase-polymerase chain reaction (rt-PCR) test, however, have been reported to have a similar risk of hospitalisation, ICU admission, ventilator use and mortality as those without asthma [93]. Thus, maintaining asthma control with appropriate asthma maintenance therapy remains vital to avoid any deterioration and subsequent need for urgent healthcare visits.

CONCLUSIONS

The pandemic was an opportunity to increase the awareness of asthma as a chronic condition and the importance of managing asthma

attacks. Well-managed asthma does not appear to worsen COVID-related outcomes, despite early concerns and may even offer some protection against COVID-related detrimental effects. Acute attacks of asthma can be well managed and, more importantly, prevented in primary care. During pandemics caused by respiratory viruses, such as in COVID-19, it is even more important for patients and PCPs to recognise asthma attacks and instigate early intervention, whether face to face or remotely. Remote assessment is more challenging but can be achieved with structural clinical assessment and the use of home monitoring devices where appropriate and available. The advice and algorithms provided in this article aim to simplify the appropriate and timely diagnosis, classification and treatment of acute attacks in adults and in teenagers. Continuity of care following an attack is crucial to establish its main cause and to agree the best preventative therapy that can help reduce further attacks. Proactive regular dosing with ICS-containing therapies achieves symptom control and reduces attacks, both of which should be targeted for effective management of asthma.

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