Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Health Care

Asthma Control in Primary Care: Inhaler Technique, Adherence, Triggers, and Guideline Implementation

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DOI: https://doi.org/10.36347/sjams.2026.v14i01.004 | **Received:** 28.10.2025 | **Accepted:** 31.12.2025 | **Published:** 08.01.2026

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Abstract **Review Article**

Background: Asthma generally goes uncontrolled in primary care despite effective inhaled therapies. Persistent symptoms, exacerbations, and avoidable health-care use are driven by suboptimal inhaler technique, poor adherence, unaddressed environmental or personal triggers, and incomplete implementation of guidelines. ***Objectives:*** To come up with feasible, primary-care strategies to improve asthma control by tackling modifiable barriers. ***Methods:*** The methods that would be taken are the narrative synthesis of evidence with the use of guidelines for practice and these would focus on inhaler technique assessment and education, adherence measurement and support, trigger identification with written action planning, and implementation tools used to embed care that would be guideline-concordant and have been incorporated into routine workflows. ***Results****:* Around half of patients use inhalers incorrectly, leading to device-specific critical errors which reduce both the delivery of drug and clinical benefit. Approximately 50% of patients adhere to controller therapy, and decisions to escalate may take place before first verifying this adherence and technique. Trigger counseling works best when incorporated in individualized asthma action plans that outline the exposures and specify the step-up actions when avoidance is not possible. A fast check [using a checklist], a short demonstration video, decision-support prompt [on an electronic health record] and a plan for follow-up. ***Conclusion:*** A structured "control circle" that iteratively reviews technique, adherence, triggers and guideline-based adjustments at every visit could provide a feasible means for better asthma outcomes in primary care across different settings.

Keywords: Asthma control, Primary care, Inhaler technique, Medication adherence, Guideline implementation.

1. INTRODUCTION

Inhalation therapy is the cornerstone of asthma management [1]. To prevent exacerbations and reduce airway inflammation, inhaled corticosteroids [ICSs] represent a pivotal intervention in asthma care [1]. However, the benefits of inhaled therapy cannot be fully realized without appropriate inhalation technique and adherence to medication [2]. Studies indicate that only 25% of asthma patients and 10% of those with chronic obstructive pulmonary disease [COPD] employ inhalers effectively [3]. Each type of inhaler requires different techniques, and many patients are frequently switched due to clinical guidelines, necessitating repeated training [4].

Despite the introduction of the respiratory inhalation control solution [RICS], which provides detailed feedback on inhalation and exhalation for five different inhalers, adherence to asthma therapy remains a substantial problem across Europe [5]. Around 50% of asthma patients adhere to prescc3b0e306-9280-4cca-813e-1f4626ac43f5ed medication plans, and 60% of severe asthma patients report poor adherence [6]. Many patients do not consider remission achievable, and dosages are modified without consulting a healthcare professional [7].

Asthma is a chronic disease that requires continuous management to prevent exacerbations and maintain control [8]. Assessing respiratory function, evaluating symptoms, adjusting medication, and tracking adherence are key elements of clinical management [9]. Guidelines recommend that adults be evaluated 1–3 months after treatment initiation or adjustment, and that children be seen every 3 months [10].

2. Inhaler Technique in Primary Care

Incorrect use of inhalers compromises the benefit of prescc3b0e306-9280-4cca-813e-1f4626ac43f5ed therapy [12]. At least 50% of patients with asthma use their inhalers incorrectly, even with adequate knowledge of the device [2]. The reasons for this bad practice are multi-faceted, including the

presence of a wide range of devices in the pharmaceutical market, patients' limited skills to operate them, cognitive impairment and a lack of medical continuity [13]. A thorough assessment of inhaler technique should therefore be performed at each routine visit by the primary care provider, following initial education and demonstration [14]. To facilitate the assessment, it is advisable to keep a short video [preferably of the specific inhaler that the patient has] accessible [15]. Gatherings of interested patients where step-by-step guidance and then assessment could occur may also positively impact inhaler mastery [11].

Directly showing patients how to use their inhalers is more effective than relying solely on verbal descriptions, and patients with correct technique have better asthma control [16]. Aims should therefore be clear—e.g. demonstrator makes an error on purpose to enable the patient to spot it [17]. Checking inhaler components and surroundings prior to use improves mindfulness and facilitates correct application [17]. Common points about device use and specifications are worth emphasizing [18]. Electric and soft mist inhalers generally require prime, and in metered-dose inhalers it is critical to actuate separately from inhalation [19]. Some devices are designed to be cleaned: specify and guide patients accordingly [20].

2.1. Assessment of Technique

Many studies have reported inadequate assessment of inhaler technique in patients with asthma and chronic obstructive pulmonary disease at all levels of the healthcare system [20]. At the primary care level, although inhalation technique remains essential, it tends to be disregarded [21]. Evaluating inhaler technique and providing corrective feedback can therefore be a valuable opportunity for every clinician, as these measures have the potential to improve medication delivery and impact disease control—especially in patients with suboptimal asthma control [22]. Despite the mid-2021 COVID-19 pandemic surge in the Latin American region, a cross-sectional oversample study showed that only twenty specific inhaler-related instructions were explicitly counted during consultations [23].

Inhaler technique errors are prevalent across all age groups, without any pattern depending on the inhaler device used, although patients with other concurrent medical problems exhibit greater difficulty mastering inhaler maneuvers [24]. The most common errors for metered dose inhalers include the failure to actuate while inhaling, not coordinating actuation with inspiration, and breath-holding; for dry powder inhalers, the most frequent mistakes entail not performing an adequate cleansing [25]. Participants using metered dose inhalers without spacers exhibit increased frequency of improper gestures and lung deposition errors [26]. Some groups of particular interest for technique evaluation encompass asthmatic patients, especially those with uncontrolled worsening under controller treatment; patients experiencing asthma ingress and requiring controller medications; concurrent respiratory illnesses impacting all inhalation maneuvers; and individuals untrained with a specific inhalation device [27].

2.2. Education and Demonstration Strategies

Asthma control can be improved through education and demonstration concerning medication delivery techniques and the importance of adhering to medication schedules [28]. Written action plans can assist afflicted patients and their families in recognizing when medication should be increased in frequency [29]. According to evidence- and practice-based asthma guidelines of the National Heart, Lung, and Blood Institute [NHLBI], the basis of asthma management is the proper selection, delivery, and adherence of medications [30].

2.3. Common Errors and Corrective Feedback

Inhaler technique is a vital component of asthma care and acts as a crucial link between medication adherence and effective symptom control [31]. Serious errors during inhalation can severely limit symptom improvement, yet studies indicate that most patients utilizing metered-dose inhalers demonstrate significant inhalation errors [20]. Moreover, inhaler errors often worsen with time and are frequently exacerbated by the introduction of a new device [32]. Copay-free medications or dose counters can be perceived as symptomatic control endpoints, rendering the technique neglected [33]. The assessment of inhaler technique thus assumes great importance in establishing the link between adherence and asthma control [31].

Four common errors impede the effective delivery of aerosolized medication through metered-dose inhalers [34]. Patients may fail to hold their breath for the recommended duration after inhalation, leading to premature exhalations that can jeopardize treatment efficacy [35]. In 65% of patients assessed, exhalations occurred prior to actuation. Exhalations continued during the actuating [17%], aspiration [10%], and inspiratory [4%] phases, significantly disrupting the inhalation sequence [36]. Wrong positioning, referring to the alteration of the inhaler's orientation, was observed in 46% of patients [37]. Seven patients instead of placing the mouthpiece between the lips pointed the inhaler nozzle toward the throat, resulting in suboptimal drug deposition in the bronchial tree [38]. Finally, three patients dispensed the dose before starting an inhalation [39]. Corrective feedback addressing these errors hence serves to improve inhaler technique and facilitate gradual symptom relief [40].

3. Adherence and Medication Management

Adherence to medication is crucial for effective asthma management [41]. Poor treatment adherence is a

frequent problem affecting children, adolescents, and adults, leading to incomplete asthma control, more exacerbations, and emergency hospitalizations [20]. The level of adherence is influenced by a variety of factors, including satisfaction with treatment, understanding of the importance of the medication, and knowledge of how to use inhalers properly [42]. Suboptimal inhaler technique, a well-established barrier to controller therapy, significantly increases the likelihood of hospitalization and emergency department visits [42]. Although the total number of prescc3b0e306-9280-4cca-813e-1f4626ac43f5ed medications is often assessed, adherence to controller therapy is frequently overlooked when clinicians consider escalating therapy [43]. Achieving better standards of adherence to asthma controller therapy, such as inhaled corticosteroids, correlates with improved symptom control, a lower risk of exacerbations, decreased oral corticosteroid use, and a reduced risk of asthma-related mortality [44].

Continued efforts are needed to foster greater adherence to treatment regimens [45]. A wide range of potential interventions is available—many of which can be integrated into well-established primary care models—that have been associated with increased adherence [46]. A patient's clinical history often provides ample justification for the application of one or more of these interventions, allowing primary care providers to improve adherence rates while reinforcing management of other comorbidities that frequently accompany asthma [47]. A focus on adherence frequently leads to the identification of poor inhaler technique or the need for further optimization of reliever therapy [48]. Electronic monitoring of treatment regimens provides a valuable source of evidence that can inform clinical decision-making about asthma therapy through the assessment of adherence [49].

3.1. Measuring Adherence

Effective and safe asthma management depends on the regular and correct use of inhalation devices [50]. Adherence is defined as the extent to which an individual's actual use of a presc3772ebf4-7c12-4e16-b030-6ee68fdecd8fed medication corresponds to the agreed recommendations from a healthcare provider [51]. The determination of adherence encompasses both patient-specific variables and the necessity for greater accountability from presc3772ebf4-7c12-4e16-b030-6ee68fdecd8fing physicians [52]. Adherence is measured with the help of biomarkers including urine samples, with the development of novel approaches such as the use of smart inhalers that indicate the time and date of each device's activation [20].

Prescription records are one of the simplest methods for evaluating adherence. Presc3772ebf4-7c12-4e16-b030-6ee68fdecd8fing medication on a repeat basis, whereby patients need to return to the presc3772ebf4-7c12-4e16-b030-6ee68fdecd8fer after several months to obtain a refill, is one practical approach for follow-up [53]. Relying solely on pharmacy records provides an incomplete understanding of adherence and medication management as patients may discontinue medication or use both preventive and reliever medicines [54]. Therefore, additional factors need to be considered when maintaining guidelines for the prescription of asthma medications [53].

3.2. Barriers to Adherence

Poor adherence to asthma therapies remains a significant barrier to optimal disease control [20]. Factors influencing adherence include inhaler mishandling, patient knowledge of inhaler technique, and patient preferences for inhaler types [55]. Inhaler reminders and technological interventions can improve adherence, especially in primary care settings [56]. Improving patient satisfaction with inhaler devices has been linked to better adherence and asthma control [57]. Strategies such as patient education, device choice tailored to patient preferences, and regular follow-up are crucial for overcoming barriers to adherence and optimizing asthma management [58].

3.3. Interventions to Improve Compliance

Nonadherence to prescribed asthma medication remains an important issue that can lead to poor asthma control [59]. Several studies report that only approximately half of patients with asthma receive controller medication according to national guidelines [46]. Compliance is often defined by patients' beliefs regarding the necessity of the medication and concerns about its adverse effects [10]. Patients may also have difficulty with prescribed medications in terms of dosing frequency and delivery-device technique provided by the prescriber [60]. Poor compliance is associated with an increased risk of asthma attacks and severe exacerbations of the disease [11]. Education can play a significant role in improving compliance, particularly by administering written asthma medication-action plans that offer personalized knowledge of asthma triggers [61].

4. Environmental and Personal Triggers

Identification of asthma triggers, distinct environmental or personal factors that stimulate the onset of asthma symptoms, is a recognized task within asthma management guidelines [20]. It is often descc3b0e306-9280-4cca-813e-1f4626ac43f5ed within the five-component "asthma control circle" that begins with assessment of the patient's perspective on and acceptance of their asthma; continues through identification of triggers, inhaler technique, and adherence; and finally circles back to the patient [62]. Although knowing the patient perspective is often considered fundamental to a controlled intervention, trigger identification remains a key, if neglected, component of asthma management [63]. Primary care practitioners—particularly in practice-based research networks—have designated trigger identification as a

core intervention for better asthma control [64]. Guidelines issued by the National Heart, Lung, and Blood Institute emphasize identifying and managing triggers as a priority [65].

Identification of triggers and patient counseling on their avoidance carry limited benefits unless the patient and practitioner collaboratively establish a meaningful regimen for managing exposure [66]. Under guidelines from the Global Initiative for Asthma, avoidance of specified triggers followed by establishment of action plans for cases of continued exposure, is indicated as a first step [67]. Furthermore, asthma-specific action plans, outlining clearly articulated conned triggering factors, provide a simple framework for documenting trigger-exposure patterns; they help the patient visualize exposure reduction and its impact on aerial function, support adherence, and email preventive instructions to a practitioner [68]. Action plans can also be integrated into general action, pain, or fever-management plans when the same triggers induce other, concomitant conditions [69].

4.1. Identifying Triggers in Primary Care

In preschool children with asthma, potential allergens include house dust mites, mold, and exposure to furry pets [70]. From 5 years, pollen from trees, grasses, and weeds also become relevant [71]. Particles from tobacco or from street and household pollution constitute important irritative triggers, in addition to respiratory infections. Other major environmental triggers include stronger pollutants, ozone, shower steam, colored atmospheres, fumes from cleaning products, and fragrances [62]. Moreover, a significant proportion of adult asthmatics experience smoke-related symptoms during smoking, exposure to second-hand smoke, or absence of frequent smoking [20].

4.2. Patient Counseling and Trigger Management

The National Asthma Education and Prevention Program recommends controlling environmental and personal asthma triggers in a systematic way [72]. Nevertheless, they are often ignored in primary care [70]. Asking patients about triggers allows primary care providers to gather information on their importance and offer advice [73]. Patients with poorly controlled asthma often suffer from one or more triggers [74]. Knowledge of triggers helps patients understand the disease's nature and how to avoid the mechanism leading to symptoms [75]. Education about triggers should be supplemented by exploring patients' knowledge of better-control methods and their attempts to avoid or limit triggers [76]. These inquiries establish rapport and can also prevent unnecessary treatment changes [77].

Triggers can be classified as environmental, psychological, exercise-related, etc. Within these broader categories, specific triggers that commonly provoke symptoms can be identified [62]. Each category can be addressed separately, with one or more more specific triggers discussed under each [62].

4.3. Avoidance and Action Plans

Inhaled corticosteroids reduce airway inflammation thus, the overall control of asthma is apparently linked to controlling triggering factors [78]. Patients with asthma often report experiencing environmental factors that exacerbate their asthma [79]. It is common to implement some "avoidance strategy" or to take extra treatment when triggers are present, but in many cases, there is no effective control [80]. Working on these "avoidance and action Plan" were among the areas rarely addressed in the guidelines [81]. It focuses on helping patients to identify trigger and amend both their environment and behaviour to minimise the influence of triggers, while acknowledging that some asthma triggers cannot be avoided and that additional treatment may be needed during a trigger episode [78].

Educational interventions that aim to increase patients' knowledge about asthma triggers have been shown to improve asthma control, especially in patients with moderate or less severe asthma [82]. Yet, this does not mean that the educative aspect should be omitted. Because education is closely associated with "avoiding" and "trigger" strategies, its implementation must be carefully monitored [83]. Reinforcement reminders via telephonic short messages may also facilitate the re-attainment of asthma control when inappropriate behavior is resumed [84]. Modifying the demography of the target group by incorporating father is essential to the success of achieving control in pediatric patients [85].

5. Guideline Implementation in Primary Care

Achieving optimal asthma control demands adherence to international guidelines [86]. However, implementation in primary care settings often encounters barriers, including insufficient medication availability, costs, systemic hindrances, and cultural factors [87]. Providing scientific evidence in formats readily understandable by providers and patients requires the use of sophisticated educational decision-support tools [88]. The Global Initiative for Asthma [GINA] guidelines set objectives for complete symptom control, minimal or no asthmaexacerbation, and no medication side effects [89]. Global assessments document poor asthma control despite the existence of clinical guidelines, showing disagreement between recommendation and practice [90]. Multicomponent intervention packages tailored for primary care can improve compliance with guideline recommendations concerning assessment of asthma control, inhaler technique, adherence to maintenance therapy, and the implementation of personal asthma action plans [1].

In an effort to support consistent application of the Asthma Guidelines, reformulating them as the Primary Care Asthma Action Plan integrates key

components into an evidence based, accessible, and user-friendly framework [91]. Action plans that incorporate assessment forms, inhaler technique checklists, and visual illustrations facilitating completion [92]. Technological advancements enable incorporation of decision-support tools within electronic health-records [93]. Practice-based quality improvement encourages divided, structured approaches to asthma management involving regular monitoring, objective assessment of control, confirmation of inhaler technique, identification of personal triggers, adjustment of therapeutic agents, and planning of follow-up [94]. Quality-improvement packages comprising teaching videos, information pamphlets, and demonstration tools targeting asthma control monitoring have also proven beneficial [95].

5.1. Evidence-Based Frameworks

Asthma is a common chronic health problem worldwide, yet many patients remain poorly controlled [96]. Of 10 347 Canadian primary care patients receiving treatment for asthma, asthma was completely controlled in only 20% of those evaluated for control; adequate control and inadequately controlled asthma were reported in 66% and 14%, respectively [97]. Similarly, only 54.6% of 1800 patients with asthma prescribed controller treatment in a British observational study reported good control [62]. Asthma-related symptoms are predictive of health-care resource use and can differentiate the experience of patients who perceive themselves as well controlled from unwell-controlled patients receiving the same pharmacotherapy [98]. In an analysis of 96 379 patients in 2005, the British General Practice Guidance Group noted that the current implementation of guidelines in primary care is inadequate—compliance is higher in secondary care, even though it accounts for only 10% of asthma patients [99]. The adoption of evidence-based frameworks, integration into electronic health records, and engagement in practice-based quality improvement are key enablers of improving guideline implementation in primary care [100].

5.2. Integration into Electronic Health Records

Information on asthma symptoms should be a routine part of every visit [78]. Integration requires consideration of workflow that encourages inquiries about current asthma control. Involvement of clinical champions who maintain interest and follow up on issues facilitates progress toward meaningful integration [100].

5.3. Practice-Based Quality Improvement

The National Asthma Education and Prevention Program recommends a continuous Quality Improvement [QI] evaluation to monitor asthma management [101]. Baseline data showed that too frequently asthma exacerbations occurred in the practice population, and the average number of asthma controller medications used was lower than recommended despite worsening of asthma symptoms [102]. Moreover, practice indicators demonstrated suboptimal assessment of trigger exposure, evaluation of symptoms, and assessment of medications used [103]. A basic clinician-oriented checklist can assist in recognizing the common barriers affecting asthma control in a primary care practice [104]. When none of the basic barriers are found in a patient, the use of a standard questionnaire may guide an efficient comparison of the patient situation with the current asthma management guidelines [105].

5.4. Shared Decision Making and Patient Education

Shared decision making [SDM] enhances clinician–patient communication regarding ideas, concerns, and preferences [106]. SDM between providers and patients has been shown to improve communication, treatment adherence, and concordance with evidence-based recommendations [107]. Asthma guidelines emphasise the importance of shared decision making [108]. Research indicates, however, that true SDM does not transpire in the majority of asthma consultations [109]. Clinicians often enter encounters with preconceived notions about patients' desires, leading to discussions about treatment options that do not align with individual needs and preferences [110]. To effectively implement SDM, practitioners should seek to understand individual patient perspectives, treatment experiences, and risk tolerance [111].

6. Special Populations and Considerations

A refined approach is needed when dealing with asthma in children and adolescents, the elderly, and people with comorbid conditions [112]. In particular, specific dosing regimens, inhaler devices, and assessment techniques may be warranted; active collaboration with professionals trained in the relevant guidelines may also be helpful [64].

Younger children typically use nebulised medication through a face mask or a metered-dose inhaler with a spacing chamber equipped with a facial mask [113]. Head positions for delivery in young children differ at home and in the clinic, and ideally this should be checked during the so-called "new baby" visit [114]. The second common age demographic is from eleven to twenty-five, when patients deal with changes such as moving away from home and gradual taking responsibility for their medication [115]. Adherence improves when physicians and patients collaborate through effective communication, motivational interviewing, decision-making, and family education [67]. In adolescents, treatment choice may affect adherence, and recent guidelines support as-needed inhaled corticosteroid/formoterol for mild asthma [93]. An adherence review by a healthcare professional trained in inhalation technique is essential during this age period [116]. Accordingly, adherence check points may be integrated into school and adolescent services, underlining the importance of triage for restricted

chronic illness and broader life-impact assessments [117].

6.1. Pediatric and Adolescent Asthma

Many children suffer from poorly controlled asthma, with rates of symptom exacerbation being particularly pronounced in pre-teen and teenage years [118]. In a cohort study, 45% of children aged 6 to 11 years and 41% aged 12 to 17 years were classified as having uncontrolled asthma [64]. Various factors contribute to poor control, including inhalation technique, adherence, environmental triggers, and symptoms that do not conform to current guidelines [119]. Addressing these factors in young patients can reduce the burden of the disease and improve their quality of life [120]. Inhalation technique should be regularly assessed and corrected as necessary; patients might also benefit from confirmation that the prescribed medicine matches the characteristics of their asthma [121]. Regular review by a healthcare professional with inhalation technique training is essential for children and adolescents, making it advisable to combine discussions of adherence with those of inhalation technique [122]. The medication prescribed plays an important role in adherence, with support from recent guidelines recommending as-needed inhaled corticosteroid/formoterol for mild asthma; the likelihood of adherence is especially improved when a combination of maintenance and reliever is used, such as a maintenance-and-relief regimen with budesonide/formoterol [123].

7. CONCLUSION

Asthma is one of the most prevalent chronic diseases in children and young adults, yet only about 25-30% of asthma patients achieve control worldwide [62]. Asthma control in young patients in many countries is classified as “poor” or “uncontrolled,” > 60 % 20. Inhaler technique, adherence to prescc3b0e306-9280-4cca-813e-1f4626ac43f5ed medication, avoidance of environmental/personal triggers, and guidelines implementation appear to be the fundamental barriers to asthma control in primary care. Asthma guidelines fail to reach more than 70% of patients globally [124]. These barriers mitigate asthma control even after pharmacological treatment and can be tackled successfully in asthma primary care [125].

Asthma guidelines span both prevention and management schemes. National prevention programs target modifiable environment and personal triggers [126]. Prescc3b0e306-9280-4cca-813e-1f4626ac43f5ing preventive measures for relevant triggers and monitoring implementation is done upfront [127]. Afterwards, stepwise management adjusted to ACT follows, while specific management of obesity, OSAS, phobia, depression or anxiety is integrated within multi-disciplinary teams [128].

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