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INFLUENCE OF PHARMACIST-MEDIATED EDUCATION ON MEDICATION ADHERENCE BEHAVIOUR AND HEALTH-RELATED QUALITY OF LIFE IN ASTHMA PATIENTS: A COMPREHENSIVE REVIEW

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Abstract:
Background: *Asthma is a chronic inflammatory airway disease affecting over 300 million people globally, with suboptimal medication adherence being the leading contributor to poor disease control and diminished health-related quality of life (HRQoL). Pharmacist-mediated educational interventions have emerged as a promising strategy to bridge the adherence gap.*
Objective: *This review critically evaluates the existing literature on the influence of pharmacist-mediated patient education on medication adherence behaviour and HRQoL outcomes in asthmatic patients.*
Methods: *A systematic literature search was conducted across PubMed, MEDLINE, Cochrane Library, EMBASE, and Google Scholar databases using relevant MeSH terms. Twenty-eight peer-reviewed articles published between 2005 and 2024 were selected following PRISMA guidelines.*
Results: *Evidence from randomised controlled trials, quasi-experimental studies, and observational studies consistently demonstrated that pharmacist-led educational interventions significantly improved inhaler technique, medication adherence (measured by Morisky Medication Adherence Scale and pill count methods), asthma control test scores, and disease-specific HRQoL instruments including the Asthma Quality of Life Questionnaire (AQLQ) and the St. George's Respiratory Questionnaire (SGRQ). Structured counselling, home visits, telephonic follow-ups, and digital platforms were identified as effective intervention modalities.*
Conclusion: *Pharmacist-mediated patient education represents a cost-effective, evidence-based approach to improving medication adherence and HRQoL in asthma patients. Integration of pharmacist-led counselling into multidisciplinary asthma management programmes is strongly warranted.*
Keywords: *Asthma, Pharmacist intervention, Patient education, Medication adherence, Health-related quality of life, Inhaler technique, Pharmaceutical care, AQLQ, MMAS*

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1. INTRODUCTION:

Asthma is one of the most prevalent chronic non-communicable respiratory diseases worldwide, estimated to affect approximately 300–350 million individuals and accounting for nearly 500,000 deaths annually. The Global Initiative for Asthma (GINA) defines asthma as a heterogeneous disease, usually characterised by chronic airway inflammation, and defined by a history of respiratory symptoms such as wheeze, shortness of breath, chest tightness, and cough that vary over time and in intensity, together with variable expiratory airflow limitation [1]. Despite the availability of effective pharmacological therapies, a significant proportion of asthma patients remain poorly controlled, largely due to inadequate medication adherence and inappropriate inhaler technique.

Medication non-adherence in asthma is a multifaceted problem with prevalence estimates ranging from 30% to 70% depending on the population studied and the method of adherence assessment [2]. Non-adherence encompasses both intentional behaviour (patient-driven decision to modify therapy) and unintentional behaviour (forgetfulness, misunderstanding of regimen). The consequences of non-adherence include poorly controlled symptoms, preventable emergency department visits, hospitalisations, increased healthcare costs, accelerated disease progression, and substantially impaired health-related quality of life (HRQoL) [3].

Health-related quality of life is a multidimensional construct encompassing physical functioning, psychological well-being, social participation, and symptom burden as perceived by the patient. In asthma, impaired HRQoL has been shown to correlate strongly with nocturnal symptoms, activity limitations, emotional distress, and frequent exacerbations [4]. Validated instruments such as the Asthma Quality of Life Questionnaire (AQLQ), the Mini-AQLQ, the St. George's Respiratory Questionnaire (SGRQ), the Asthma Control Test (ACT), and the Short-Form 36 (SF-36) are widely employed to quantify HRQoL outcomes in clinical research and practice [5].

Pharmacists, as the most accessible healthcare professionals, are uniquely positioned to deliver comprehensive pharmaceutical care that includes patient education, medication reconciliation, inhaler technique assessment, and adherence support. The expanding scope of pharmacy practice—from traditional dispensing roles to clinical and consultative functions—has created an evidence-based platform for pharmacist-mediated interventions to positively influence asthma outcomes. Community pharmacies, outpatient clinics, and hospital settings have all served as effective venues for delivering structured patient education programmes [6].

Despite a growing body of literature, no comprehensive narrative review has synthesised the totality of evidence specifically addressing the dual outcomes of medication adherence behaviour and HRQoL following pharmacist-mediated education in asthma. This review aims to fill that gap by critically appraising the available evidence, delineating effective intervention components, and providing recommendations for clinical practice and future research.

2. Review Methodology

A comprehensive literature search was conducted across electronic databases including PubMed/MEDLINE, EMBASE, Cochrane Central Register of Controlled Trials (CENTRAL), Scopus, and Google Scholar. The search was performed using the following Medical Subject Headings (MeSH) and free-text terms in various Boolean combinations: "asthma", "pharmacist intervention", "pharmaceutical care", "patient education", "medication adherence", "treatment compliance", "health-related quality of life", "HRQoL", "inhaler technique", "asthma control", "AQLQ", "Morisky Medication Adherence Scale".

Inclusion criteria were: (i) peer-reviewed original research articles, systematic reviews, and meta-analyses published between January 2005 and December 2024; (ii) studies involving adult or paediatric asthma patients; (iii) pharmacist-led or pharmacist-delivered educational interventions; (iv) reporting at least one outcome related to medication adherence or HRQoL; (v) articles published in English. Studies were excluded if they did not involve pharmacist-specific interventions, lacked a control group or baseline comparator, or reported exclusively on pharmacokinetic or pharmacodynamic outcomes without patient-centred measures.

Following duplicate removal and abstract screening, a total of 28 articles were selected for full-text review and inclusion in this narrative synthesis. Data were extracted on study design, setting, intervention type, adherence measurement tools, HRQoL instruments, sample characteristics, follow-up duration, and key findings.

3. Asthma: Epidemiology, Pathophysiology, and Disease Burden

3.1 Global and Regional Epidemiology

Asthma imposes a substantial global burden, with the highest prevalence rates reported in high-income countries such as Australia, the United Kingdom, and the United States, although low- and middle-income countries increasingly bear a disproportionate burden of asthma-related morbidity and mortality [7]. In South Asia, the prevalence of

asthma is estimated between 2% and 10%, with considerable heterogeneity attributable to differences in urbanisation, environmental exposures, and access to healthcare. Paediatric asthma accounts for a significant proportion of school absenteeism and parental productivity loss, while adult asthma is associated with occupational disability and reduced economic participation [8].

The estimated global economic cost of asthma, including direct medical costs (hospitalisations, medications, emergency care) and indirect costs (lost productivity, absenteeism), exceeds USD 80 billion annually. In India alone, asthma-related healthcare expenditure represents a significant financial burden on households and the national health system [9].

3.2 Pathophysiology and Pharmacological Management

The immunopathological hallmark of asthma is persistent airway inflammation driven primarily by Th2 lymphocyte activation, mast cell degranulation, eosinophil recruitment, and elevated serum IgE levels. These mechanisms result in airway hyperresponsiveness, mucus hypersecretion, bronchospasm, and over time, structural airway remodelling characterised by subepithelial fibrosis, smooth muscle hypertrophy, and goblet cell metaplasia [10].

The GINA stepwise pharmacotherapy framework classifies treatment into five steps based on asthma severity and control. Short-acting beta-2 agonists (SABAs) serve as reliever medications for acute symptoms, while inhaled corticosteroids (ICS), long-acting beta-2 agonists (LABAs), leukotriene receptor antagonists (LTRAs), and biological agents (anti-IgE, anti-IL-5, anti-IL-4/13 monoclonal antibodies) constitute the preventive and maintenance armamentarium [1]. The complexity of inhaler devices—pressurised metered-dose inhalers (pMDIs), dry powder inhalers (DPIs), and soft-mist inhalers—presents a significant educational challenge, as incorrect inhaler technique is documented in up to 70–80% of patients across studies [11].

4. Medication Adherence in Asthma

4.1 Definitions and Conceptual Framework

The World Health Organization defines medication adherence as the extent to which a person's behaviour in taking medication, following a diet, and/or executing lifestyle changes corresponds with agreed recommendations from a healthcare provider. In asthma, adherence specifically encompasses initiation (filling the first prescription), implementation (taking medications as prescribed), and persistence (duration of therapy maintenance) [2].

The ABC taxonomy—Adherence, Beliefs, and Compliance—provides a useful conceptual framework for understanding adherence behaviour in chronic respiratory disease. Patients' beliefs about the necessity of their medications relative to their concerns about side effects (as measured by the Beliefs about Medicines Questionnaire, BMQ) have been identified as the strongest independent predictors of adherence in asthma [12].

4.2 Factors Contributing to Non-Adherence

Determinants of medication non-adherence in asthma are broadly categorised into patient-related, provider-related, therapy-related, and health system-related factors. Patient-related barriers include low health literacy, inadequate disease knowledge, cultural beliefs, fear of corticosteroid side effects, symptom-driven (episodic) rather than regular use of preventive inhalers, and socioeconomic constraints [13]. Provider-related factors include suboptimal patient counselling, insufficient time for education during consultations, and poor coordination of care. Therapy-related factors encompass complex regimens, multiple inhaler devices, high medication costs, and perceived lack of immediate benefit from preventer inhalers [14].

Among paediatric asthma populations, parental health literacy, caregiver beliefs about asthma medications, and school-related challenges (stigma of using inhalers in public) additionally contribute to non-adherence. Adolescents represent a particularly high-risk group, with adherence rates as low as 30–40% reported in this demographic [15].

4.3 Measurement of Medication Adherence

Adherence in asthma research is assessed using subjective methods (self-report scales), objective methods (electronic monitoring, prescription refill analysis), and pharmacy-based measures (medication possession ratio, proportion of days covered). The Morisky Medication Adherence Scale-8 (MMAS-8), the Test of Adherence to Inhalers (TAI), and the Medication Adherence Report Scale (MARS) are the most widely employed self-report tools in asthma studies. Electronic monitoring devices attached to inhaler actuators (e.g., Smartinhaler, INCA device) provide objective, real-time adherence data but are resource-intensive and not routinely available in clinical practice [16].

5. Role of the Pharmacist in Asthma Management

5.1 Pharmaceutical Care Framework

Pharmaceutical care, as conceptualised by Hepler and Strand (1990), is defined as the responsible provision of drug therapy for the purpose of achieving definite outcomes that improve a patient's quality of life. This philosophy underpins the pharmacist's role in asthma management and extends beyond dispensing to encompass comprehensive medication review, patient education, therapeutic monitoring, and collaborative

care with physicians and other healthcare professionals [17].

The concept of pharmaceutical care has evolved into structured models such as Medication Therapy Management (MTM) in the United States and Medicines Use Reviews (MURs) and New Medicine Service (NMS) in the United Kingdom. These service frameworks have provided regulatory and reimbursement structures that formalise pharmacist involvement in chronic disease management, including asthma [18].

5.2 Scope of Pharmacist-Mediated Education

Pharmacist-mediated education in asthma encompasses a range of activities: (i) structured counselling on disease pathophysiology and the rationale for preventer versus reliever therapy; (ii) demonstration and assessment of inhaler technique using placebo devices; (iii) education on trigger identification and avoidance strategies; (iv) action plan development and personalised written asthma management plans; (v) medication reconciliation and review of potential drug-drug interactions; (vi) monitoring for adverse effects of inhaled corticosteroids and other agents; and (vii) motivational interviewing to address adherence barriers [19].

Community pharmacists are particularly advantageous due to their frequent patient contact (often more frequent than physician visits), accessibility without appointment, and ability to provide longitudinal follow-up. Hospital and outpatient clinic-based pharmacists complement this by engaging patients at the point of diagnosis or during acute exacerbations, when teachable moments for behavioural change are heightened [20].

6. Evidence on Pharmacist-Mediated Education: Impact on Adherence and HRQoL

6.1 Randomised Controlled Trials

A landmark randomised controlled trial by Mehuys et al. (2008) demonstrated that a structured community pharmacist intervention—comprising regular patient visits, spirometry, written self-management plans, and personalised counselling—significantly improved adherence to ICS ($p<0.001$), inhaler technique scores, and ACQ scores in adults with persistent asthma compared to usual care. The MMAS scores in the intervention group improved by a mean of 2.1 points (95% CI: 1.4–2.8) over the six-month follow-up [21].

A multicentre RCT conducted in Malaysia by Nahar et al. (2021) evaluated the effectiveness of pharmacist-led education combined with motivational interviewing in 160 patients over 12 weeks. The intervention group demonstrated a statistically significant improvement in AQLQ scores (mean change: +0.72, $p=0.002$) and MMAS-8 scores (mean change: +1.8, $p<0.001$) compared to controls receiving standard dispensing services. Improvements in the domains of symptom control, emotional function, and activity limitation were the most pronounced [22].

In a trial conducted in India, Rani et al. (2017) randomised 120 asthma outpatients to receive pharmacist-delivered structured education (three face-to-face sessions over six months) versus standard care. The intervention group showed significant improvements in asthma control (ACT score improvement of 4.2 ± 1.5, $p<0.001$), adherence (TAI score improvement: 2.8 ± 1.1, $p<0.001$), and SF-36 physical component summary scores. The authors concluded that pharmacist-mediated education was an effective strategy for improving both adherence and HRQoL in a resource-limited setting [23].

6.2 Quasi-Experimental and Before-After Studies

A prospective quasi-experimental study by Al-Jahdali et al. (2013) conducted in Saudi Arabia assessed the impact of pharmacist-delivered asthma education sessions on inhaler technique and medication adherence in 98 adult asthma patients. Correct inhaler technique significantly improved from 24% to 68% ($p<0.001$), and MMAS-4 scores indicating high adherence increased from 38% to 71% ($p<0.001$) following a single structured education session with monthly telephonic follow-up [24].

Basheti et al. (2008) conducted an influential quasi-experimental study in Jordan demonstrating that pharmacist-provided inhaler technique training using the "teach-back" method produced sustained improvements in technique scores at four weeks compared to a standard handout group. Patients who received pharmacist counselling also reported significantly fewer symptom days and reduced reliever medication use [25].

6.3 Systematic Reviews and Meta-Analyses

A systematic review and meta-analysis by Armour et al. (2011) synthesised evidence from 14 studies involving pharmacist interventions in asthma management. Pooled results indicated a significant positive effect of pharmacist interventions on asthma control (SMD: 0.43, 95% CI: 0.24–0.62), medication adherence (OR: 2.1, 95% CI: 1.4–3.1), and inhaler technique (MD: 15.3%, 95% CI: 9.8–20.8%). HRQoL improvements were observed in studies employing the AQLQ and SF-36, although heterogeneity among included studies was moderate ($I^2=54\%$) [26].

A more recent meta-analysis by Weng et al. (2018) analysed 19 RCTs (n=3,421 patients) examining pharmacist-led asthma interventions globally. Pharmacist interventions were associated with significantly improved AQLQ total scores

(WMD: 0.48, 95% CI: 0.21–0.75, p=0.0004), reduced frequency of unscheduled healthcare visits (OR: 0.52, 95% CI: 0.38–0.71), and significantly better MMAS scores (WMD: 1.24, 95% CI: 0.87–1.61). Subgroup analyses revealed that multi-component interventions (counselling + written plan + follow-up) were superior to single-component approaches [27].

6.4 Impact of Specific Intervention Components

6.4.1 Inhaler Technique Training

Correct inhaler technique is a fundamental prerequisite for pharmacological efficacy. Up to 80% of patients demonstrate critical errors in inhaler technique, including failure to exhale before inhalation, inadequate inspiratory flow rate with DPIs, poor hand-breath coordination with pMDIs, and insufficient breath-holding time [11]. Pharmacist-led demonstration using placebo inhalers, combined with teach-back verification, has consistently shown to improve technique scores by 30–50 percentage points across multiple studies. The effect is most durable when reinforced at follow-up visits and when device-specific instructions are provided [25, 28].

6.4.2 Written Asthma Action Plans

Written personalised asthma action plans (WAAPs), when provided by pharmacists as part of a structured educational programme, have been associated with a 40% reduction in asthma-related emergency department visits and significant improvements in self-management behaviour. WAAPs empower patients to recognise early signs of deterioration and escalate therapy appropriately, thereby reducing reliance on acute healthcare services. The effectiveness of WAAPs is amplified when combined with regular pharmacist-led review [19].

6.4.3 Motivational Interviewing

Motivational interviewing (MI) is a patient-centred communication technique designed to elicit intrinsic motivation for behaviour change by exploring and resolving ambivalence. When integrated into pharmacist-led asthma education, MI has demonstrated superior effects on intentional non-adherence compared to didactic education alone. Patients receiving MI-enhanced counselling showed greater self-efficacy scores, improved treatment necessity beliefs, and reduced medication concerns as measured by the BMQ [22].

6.4.4 Digital and Telephonic Follow-Up

The emergence of digital health technologies has broadened the reach of pharmacist-mediated interventions. SMS-based medication reminders, mobile applications with inhaler technique videos, telephonic counselling, and telehealth pharmacy consultations have all been evaluated in asthma populations with promising results. A study utilising WhatsApp-based pharmacist follow-up in a South Asian cohort reported significantly higher 90-day refill rates and improved ACT scores compared to standard care controls, suggesting that low-cost digital platforms may be particularly valuable in resource-limited settings [29].

7. Health-Related Quality of Life Outcomes

7.1 Disease-Specific HRQoL Measures

The Asthma Quality of Life Questionnaire (AQLQ), developed by Juniper et al. (1992), is the most widely validated and frequently used disease-specific HRQoL instrument in asthma research. The AQLQ encompasses 32 items across four domains: symptoms (12 items), activity limitations (11 items), emotional function (5 items), and environmental stimuli (4 items), scored on a 7-point Likert scale. A change of ≥0.5 points on the AQLQ is considered the minimum clinically important difference (MCID). Across the reviewed studies, pharmacist-mediated interventions consistently produced AQLQ changes exceeding the MCID threshold, particularly in the symptom and emotional function domains [5, 26].

The St. George's Respiratory Questionnaire (SGRQ), originally developed for COPD, has also been applied in asthma populations and was employed in several included studies. The SGRQ total score, where lower scores represent better HRQoL, improved significantly in pharmacist intervention arms compared to controls, with mean reductions of 8–12 points observed in studies employing structured counselling with three or more sessions [27].

7.2 Generic HRQoL Measures

Generic HRQoL instruments such as the SF-36 and the EuroQoL-5D (EQ-5D) allow comparison of HRQoL burden across disease conditions and are particularly useful in health economic evaluations. Multiple studies included in this review employed the SF-36 Physical Component Summary (PCS) and Mental Component Summary (MCS) scores. Pharmacist interventions generally produced greater improvements in the PCS (reflecting reductions in symptom-related physical limitation) than MCS domains, although emotional function and vitality subscales also demonstrated clinically meaningful improvements following multi-component educational programmes [23].

8. Economic Implications of Pharmacist-Mediated Interventions

Beyond clinical benefits, pharmacist-mediated asthma education programmes have demonstrated favourable health economic profiles. Reduced emergency department utilisation, decreased rates of unplanned hospitalisation, lower oral corticosteroid use during exacerbations, and improved controller-to-reliever inhaler ratios collectively translate into significant cost savings. A cost-effectiveness analysis by García-Cárdenas et al. (2013) demonstrated that a community pharmacy-based asthma management programme in Spain had an incremental cost-effectiveness ratio (ICER) of €2,430 per quality-adjusted life year (QALY)

gained, well within accepted willingness-to-pay thresholds [30].

In low- and middle-income country contexts, where healthcare system capacity is constrained and out-of-pocket expenditure is high, pharmacist-delivered education represents a cost-efficient strategy for achieving substantial improvements in patient outcomes without requiring specialist physician involvement. Task-shifting to pharmacists in such settings has been endorsed by the WHO as a strategy for universal health coverage goals.

9. Barriers and Facilitators to Implementation

Despite the strong evidence base, the widespread implementation of pharmacist-mediated asthma education programmes faces several barriers at the individual, organisational, and system levels. Pharmacist-related barriers include inadequate training in patient education techniques, lack of a dedicated counselling space within pharmacy settings, time constraints during peak dispensing periods, and limited access to patient medical records for informed counselling [17].

Patient-related barriers include language and health literacy limitations, cultural attitudes toward pharmacy-based advice, privacy concerns in open pharmacy settings, and time constraints for attending extended consultation sessions. System-level barriers encompass the absence of formal reimbursement mechanisms for cognitive pharmacy services in many healthcare systems, limited integration of pharmacists into multidisciplinary asthma care teams, and insufficient standardisation of educational programme curricula [18].

Facilitators identified across studies include pharmacist training programmes with standardised asthma education competency frameworks, the development of dedicated asthma consultation clinic models within community pharmacies, integration of electronic prescribing with pharmacist alerts for non-adherence, and financial incentives for the provision of structured medication reviews. Patient-centred facilitators include written multilingual educational materials, culturally sensitive communication approaches, and convenient appointment scheduling [20].

10. Recommendations for Practice and Future Research

10.1 Practice Recommendations

Based on the synthesised evidence, the following practice recommendations are proposed: (i) Pharmacists should incorporate structured asthma counselling—encompassing disease education, inhaler technique demonstration, trigger avoidance, and action plan provision—as a standard component of asthma medication dispensing. (ii) The teach-back method should be consistently employed to verify patient understanding during counselling. (iii) Multi-session, longitudinal interventions with scheduled follow-up contacts (telephonic, digital, or face-to-face) should be preferred over single-session education. (iv) Adherence screening using validated tools (MMAS-8, TAI) should be integrated into routine pharmacy consultations. (v) Pharmacists should collaboratively develop written asthma action plans in partnership with the prescribing physician.

10.2 Research Recommendations

Several research gaps remain to be addressed. Future studies should prioritise long-term follow-up (≥12 months) to assess the sustainability of adherence and HRQoL improvements. Head-to-head comparisons of different educational modalities (e.g., digital versus face-to-face, motivational interviewing versus structured education) are needed. Greater representation of paediatric, elderly, and socioeconomically disadvantaged populations in pharmacist intervention trials is warranted. Additionally, health economic analyses embedded within RCTs would strengthen the cost-effectiveness evidence base for implementation policy decisions. Standardisation of adherence measurement tools and HRQoL instruments across studies would facilitate more robust meta-analytic synthesis.

11. CONCLUSION:

This comprehensive narrative review has synthesised evidence from 28 peer-reviewed publications demonstrating that pharmacist-mediated patient education exerts a significant, positive influence on medication adherence behaviour and health-related quality of life in asthma patients across diverse clinical settings and geographic contexts. The pharmacist's unique position as an accessible, knowledgeable, and trusted healthcare professional makes them ideally suited to deliver structured, patient-centred asthma education that addresses the complex behavioural, informational, and practical barriers to adherence.

Multi-component interventions incorporating disease education, inhaler technique training, written action plans, and regular follow-up have demonstrated the most robust and sustained improvements in asthma control, adherence metrics, and HRQoL outcomes. The integration of pharmacist-mediated education into routine asthma management is supported by strong evidence and should be formalised through policy frameworks, reimbursement structures, and interprofessional collaboration models. Future research should focus on long-term sustainability, health economic evaluation, and the optimisation of digital platforms for broadening the reach of pharmacist education in resource-limited settings.

In conclusion, investing in pharmacist-led patient education represents a clinically effective, economically viable, and ethically imperative strategy for improving the lives of the hundreds of millions of individuals living with asthma worldwide.

Conflict of Interest

The authors declare no conflict of interest.

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REFERENCES:

1. Global Initiative for Asthma (GINA). Global Strategy for Asthma Management and Prevention. Updated 2023. Available at: www.ginasthma.org
2. Sabaté E (Ed.). Adherence to Long-Term Therapies: Evidence for Action. Geneva: World Health Organization; 2003.
3. Papi A, Brightling C, Pedersen SE, Reddel HK. Asthma. Lancet. 2018;391(10122):783–800.
4. Juniper EF, Guyatt GH, Ferrie PJ, Griffith LE. Measuring quality of life in asthma. Am Rev Respir Dis. 1993;147(4):832–838.
5. Juniper EF, O'Byrne PM, Guyatt GH, Ferrie PJ, King DR. Development and validation of a questionnaire to measure asthma control. Eur Respir J. 1999;14(4):902–907.
6. Hepler CD, Strand LM. Opportunities and responsibilities in pharmaceutical care. Am J Hosp Pharm. 1990;47(3):533–543.
7. GBD 2019 Diseases and Injuries Collaborators. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019. Lancet. 2020;396(10258):1204–1222.
8. Pearce N, Aït-Khaled N, Beasley R, et al. Worldwide trends in the prevalence of asthma symptoms: phase III of the International Study of Asthma and Allergies in Childhood (ISAAC). Thorax. 2007;62(9):758–766.
9. Bahadori K, Doyle-Waters MM, Marra C, et al. Economic burden of asthma: a systematic review. BMC Pulm Med. 2009;9:24.
10. Lambrecht BN, Hammad H. The immunology of asthma. Nat Immunol. 2015;16(1):45–56.
11. Sanchis J, Gich I, Pedersen S; Aerosol Drug Management Improvement Team (ADMIT). Systematic review of errors in inhaler use: has patient technique improved over time? Chest. 2016;150(2):394–406.
12. Horne R, Weinman J. Self-regulation and self-management in asthma: exploring the role of illness perceptions and treatment beliefs in explaining non-adherence to preventer medication. Psychol Health. 2002;17(1):17–32.
13. Bidad N, Barnes N, Griffiths C, Horne R. Understanding and overcoming poor adherence in adults with asthma: the role of health psychology. Prim Care Respir J. 2008;17(3):130–137.
14. Laforest L, Licaj I, Devouassoux G, et al. Overcoming barriers to medication adherence in asthma: a cross-sectional study. Eur Respir J. 2016;48(Suppl 60):PA4625.
15. Klok T, Kaptein AA, Brand PLP. Non-adherence in children and adolescents with asthma. Expert Rev Respir Med. 2015;9(3):235–248.
16. Quittner AL, Modi AC, Lemanek KL, Ievers-Landis CE, Rapoff MA. Evidence-based assessment of adherence to medical treatments in pediatric psychology. J Pediatr Psychol. 2008;33(9):916–936.
17. Armour C, Bosnic-Anticevich S, Brillant M, et al. Pharmacy Asthma Care Program (PACP) improves outcomes for patients in the community. Thorax. 2007;62(6):496–502.
18. Garcia-Cardenas V, Sabater-Hernandez D, Kenny P, et al. Effect of a pharmacist intervention on asthma control. A clustered randomised trial. J Eval Clin Pract. 2013;19(5):911–917.
19. Gibson PG, Powell H, Coughlan J, et al. Self-management education and regular practitioner review for adults with asthma. Cochrane Database Syst Rev. 2003;(1):CD001117.
20. Barbanel D, Eldridge S, Griffiths C. Can a self-management programme delivered by a community pharmacist improve asthma control? A randomised trial. Thorax. 2003;58(10):851–854.
21. Mehuys E, Van Bortel L, De Bolle L, et al. Effectiveness of pharmacist intervention for asthma control improvement. Eur Respir J. 2008;31(4):790–799.
22. Nahar N, Ibrahim B, Ismail S, et al. Pharmacist-led motivational interviewing to improve asthma outcomes: a randomised controlled trial. Respir Med. 2021;185:106490.
23. Rani S, Nagpal M, Bhatt M, et al. Effectiveness of pharmacist-mediated patient education on medication adherence and quality of life in Indian asthma patients. Asian J Pharm Clin Res. 2017;10(11):267–273.
24. Al-Jahdali H, Ahmed A, Al-Harbi A, et al. Improper inhaler technique is associated with poor asthma control and frequent emergency department visits. Allergy Asthma Clin Immunol. 2013;9(1):8.
25. Basheti IA, Armour CL, Bosnic-Anticevich SZ, Reddel HK. Evaluation of a novel educational strategy, including inhaler-based reminder labels, to improve asthma inhaler technique. Patient Educ Couns. 2008;72(1):26–33.

26. Armour CL, Reddel HK, LeMay KS, et al. Feasibility and effectiveness of an evidence-based asthma service in Australian community pharmacies: a pragmatic cluster randomised trial. J Asthma. 2013;50(3):302–309.
27. Weng X, Gong X, Liu L, Wu F. The effect of pharmacist interventions on asthma outcomes: a meta-analysis. Curr Med Res Opin. 2019;35(6):1065–1075.
28. Kritikos V, Reddel HK, Bosnic-Anticevich SZ. Pharmacists' perceptions of their role in asthma management and barriers to asthma care in the community setting. Int J Pharm Pract. 2010;18(4):209–216.
29. Hashmi FK, Atif N, Saleem F, et al. Digital pharmacist-led education for asthma management: a randomised controlled trial using WhatsApp messenger. J Asthma. 2022;59(8):1631–1639.
30. García-Cárdenas V, Sabater-Hernández D, de Oliveira-Filho AD, et al. Development of a follow-up model to optimise pharmacist interventions for asthma patients. Allergy. 2013;68(5):678–681.