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Improving Asthma Knowledge and Inhaler Technique with a Pharmacist-Directed Artificial Intelligence Tool

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ABSTRACT

Poor asthma outcomes are frequently linked to incorrect inhaler use and limited patient understanding. While community pharmacists play a crucial role in patient education, relying solely on verbal explanations may not be efficient in busy pharmacy environments. Artificial intelligence (AI)–based tools offer an engaging and tailored method for delivering asthma self-management support. This study explored how pharmacist-facilitated AI education influences patients' inhaler skills and asthma comprehension in Jordan. A pre–post interventional design was used in five community pharmacies located in southern Jordan. Adult asthma patients (≥18 years) who were prescribed metered-dose or dry-powder inhalers attended 20–30 minute pharmacist-led sessions combining traditional instruction with AI-powered interactive demonstrations. Outcomes included asthma knowledge (evaluated by a 10-question test) and inhaler performance (assessed using a 10-step checklist) at baseline and one week after the educational session. The study enrolled 400 participants (59% female; mean age 42.3 ± 14.8 years). Correct inhaler use increased substantially from 42% before the intervention to 89% afterward (difference 47%; 95% CI: 41–53; $p < 0.001$). Knowledge scores improved significantly from 4.3 ± 1.2 to 8.5 ± 1.0 (mean change +4.2; 95% CI: 4.0–4.4; $p < 0.001$). The largest improvements were seen among female participants and those with university-level education. A strong positive association was found between knowledge and inhaler performance ($r = 0.71$). Integrating AI-based learning with pharmacist guidance led to significant advancements in both asthma knowledge and inhaler handling. This practical and scalable approach may enhance patient care within community pharmacies and contribute to international efforts aimed at improving asthma management and self-care practices.

Keywords: Pharmacy, Artificial intelligence, Community pharmacy services, Asthma, Inhalation technique, Education

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Introduction

Asthma is a chronic inflammatory respiratory disorder that continues to pose a significant global health challenge, affecting over 262 million individuals and contributing to nearly 455,000 deaths annually [1]. Inhaled therapies are the preferred approach for asthma control due to their ability to deliver medication directly to the lungs, offering rapid relief and minimal systemic exposure. Among these, metered-dose inhalers (MDIs) and dry-powder inhalers (DPIs) are the most frequently prescribed delivery systems [2].

Despite these benefits, improper inhaler use remains widespread. Typical mistakes include poor synchronization of inhalation with device actuation, inadequate inspiratory force, and failure to exhale before inhalation [3]. Such errors diminish drug delivery to the lungs, leading to poor disease control, preventable exacerbations, and higher healthcare costs.

Enhancing patient education on proper inhaler handling is therefore a critical component of asthma management. Community pharmacists, who are among the most accessible healthcare professionals, are uniquely positioned to assess and correct inhaler misuse [4]. Evidence from European pharmacy-based interventions—such as those

conducted in Spain, the United Kingdom, and Bulgaria—shows that structured pharmacist-led education programs can improve both inhaler technique and clinical outcomes, suggesting their adaptability in broader contexts [5, 6]. Nevertheless, in busy pharmacy environments, relying solely on verbal counseling may limit the effectiveness of such interventions. Artificial intelligence (AI)–based educational systems offer a modern alternative by providing interactive, adaptive, and personalized learning experiences that enhance patient engagement, knowledge retention, and self-care abilities [7]. However, limited evidence exists regarding their real-world use in community pharmacy practice, particularly in resource-limited countries [8].

This study therefore aimed to investigate how pharmacist-delivered, AI-assisted asthma education affects inhaler technique and disease-related knowledge among patients visiting community pharmacies in Jordan.

Materials and Methods

Study design and setting

A pre–post intervention study was carried out from January to March 2025 in five community pharmacies located in southern Jordan. The selected pharmacies met the inclusion criteria based on patient traffic, availability of private consultation areas, and pharmacist's willingness to engage in the study.

Participants

Eligible participants were adults aged 18 years and above, clinically diagnosed with asthma and prescribed either an MDI or a DPI. Exclusion criteria included cognitive impairment, communication difficulties, or refusal to sign consent forms. Recruitment was performed by pharmacists during prescription refills, and written informed consent was obtained before participation.

Pharmacist preparation

All pharmacists involved in the study attended a two-day preparatory workshop before implementation. The training included:

- Standardized use of the Global Initiative for Asthma (GINA) 10-step checklist for inhaler technique evaluation [9].
- Administration of a validated 10-item asthma knowledge test [10, 11].
- Hands-on training with the AI platform, focusing on operation, troubleshooting, and monitoring patient interaction.
- Ethical guidance emphasizing confidentiality and responsible digital tool usage in patient care.

Intervention

Participants received a pharmacist-guided educational session supported by an AI-based interactive platform lasting about 20–30 minutes. The process involved:

- Initial assessment: Patients demonstrated their inhaler technique and completed the knowledge questionnaire.
- AI-driven education: The platform provided tailored instruction using animations, auditory prompts, and interactive corrections based on the patient's literacy and baseline knowledge.
- Pharmacist support: Pharmacists supervised learning, provided corrective feedback, and encouraged practice with personal or demo inhalers.
- Ongoing reinforcement: An AI chatbot was available for one week post-intervention to address questions and reinforce proper inhaler technique.

Outcome evaluation

- Asthma knowledge: Measured using a validated 10-item questionnaire (score range 0–10), where higher scores indicated greater knowledge.
- Inhaler technique: Evaluated using the GINA 10-step checklist, with "correct use" defined as successful completion of all steps.

Follow-up

After one week, participants were reassessed using the same questionnaire and checklist to determine changes in knowledge and inhaler performance.

Statistical analysis

Data analysis was conducted using SPSS version 26 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD) with 95% confidence intervals (CIs), and categorical data as frequencies and percentages. Paired t-tests were used to compare pre- and post-intervention knowledge scores, while chi-square tests evaluated improvements in technique. Logistic regression models identified predictors of improvement (gender, age, education), and Pearson's correlation coefficient (r) assessed associations between knowledge and technique. Significance was set at $p < 0.05$.

Ethical approval

Ethical clearance was granted by the Scientific Research Committee of the School of Pharmacy, Mutah University (Approval No. SERC 2024–2025/24; December 1, 2024), following the ethical standards of the Declaration of Helsinki. Written informed consent was secured from all participants.

Results and Discussion

Participant demographics

Four hundred patients were included in the final analysis (59% female; mean age 42.3 ± 14.8 years). Nearly half (45%) were between 31 and 50 years old, and 42% possessed tertiary education qualifications **(Table 1).**

Table 1. Participant Demographic Characteristics

Characteristic	N (%)
Gender	
Female	236 (59.0)
Male	164 (41.0)
Age Group (years)	
18–30	102 (25.5)
31–50	180 (45.0)
>50	118 (29.5)
Education Level	
Primary or below	88 (22.0)
Secondary	144 (36.0)
Higher (tertiary) education	168 (42.0)

Primary outcomes

At the start of the study, only 42 percent of participants (168 out of 400) correctly performed the inhaler technique. After the intervention, this increased to 89 percent (356 out of 400), reflecting an absolute gain of 47 percent (95 percent CI: 41–53; $p < 0.001$).

Asthma knowledge also showed significant improvement, with mean scores rising from 4.3 ± 1.2 at baseline to 8.5 ± 1.0 after the intervention, representing an average increase of 4.2 points (95 percent CI: 4.0–4.4; $p < 0.001$) **(Table 2).**

Table 2. Pre- and post-intervention outcomes.

Outcome	Baseline	Post-intervention	Difference (95% CI)	p-value
Correct inhaler use	42% (168/400)	89% (356/400)	+47% (41–53)	<0.001
Knowledge score	4.3 ± 1.2	8.5 ± 1.0	+4.2 (4.0–4.4)	<0.001

Subgroup analyses

The extent of improvement varied by educational attainment **(Table 3)**, with participants holding tertiary education experiencing the largest gains, though all education levels demonstrated significant progress.

Table 3. Improvement by education level.

Education level	Technique gain (%)	Knowledge gain (Mean ± SD)
Primary or less	+35%	+3.1 ± 0.9
Secondary	+48%	+3.9 ± 1.1
Tertiary	+61%	+4.8 ± 1.0

Predictors of improvement

Logistic regression analysis revealed that being female (OR 1.45, 95 percent CI: 1.06–1.98; p = 0.021) and having a tertiary-level education (OR 2.11, 95 percent CI: 1.52–2.91; p < 0.001) were significantly associated with a higher likelihood of improvement, whereas age did not significantly influence outcomes **(Table 4).**

Table 4. Logistic regression results.

Variable	OR	95% CI	p-value
Female (vs. Male)	1.45	1.06–1.98	0.021
Tertiary education	2.11	1.52–2.91	<0.001
Age > 50 (vs. < 30)	0.88	0.63–1.22	0.446

Correlation analysis

Inhaler technique and asthma knowledge showed a strong positive association (r = 0.71, p < 0.001), and a similar positive relationship was observed between knowledge, skills, and confidence (r = 0.66, p < 0.001).

This study revealed that combining pharmacist guidance with AI-assisted education substantially enhanced patients' inhaler skills and asthma understanding. The number of participants demonstrating correct inhaler use almost doubled, while average knowledge scores increased by more than four points, highlighting the effectiveness of integrating professional counseling with digital tools to support self-management.

These results are in line with previous studies demonstrating that pharmacist interventions can improve asthma outcomes [12-14] and echo findings from European and Bulgarian programs emphasizing the central role of pharmacists in chronic disease education and management [15, 16].

The addition of AI technology provided interactive and personalized learning, complementing traditional counseling. Similar digital solutions have shown benefits for self-management in other chronic diseases [17, 18].

The observed strong correlations between knowledge, skills, and confidence indicate that pharmacist-led AI interventions can effectively enhance both understanding and practical competence in asthma care.

Implementing such approaches in real-world pharmacy settings may face challenges, including the need for adequate digital literacy among pharmacists, workflow modifications to allow time for structured sessions, and stringent data privacy measures. Evaluating cost-effectiveness is also necessary to support sustainable adoption, especially in resource-constrained environments [19].

Conclusion

Education delivered by pharmacists, reinforced with AI, led to notable improvements in inhaler technique and asthma knowledge in Jordanian community pharmacies. This combination of professional expertise and digital tools demonstrates promise for advancing pharmaceutical care and patient self-management.

Future research should explore randomized controlled trials, long-term retention of skills and knowledge, and clinical outcomes such as symptom control and healthcare utilization. Expanding this model internationally, including in European and Bulgarian contexts, may offer a meaningful contribution to global asthma management strategies.

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