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Inhaler technique and asthma: Feasability and acceptability of training by pharmacists

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Summary
Poor inhaler technique is frequent in asthma, but its long-term consequences have been seldom assessed. Pharmacists are ideally positioned to teach inhaler technique.

This prospective observational study evaluated the feasibility of inhaler training by pharmacists in patients receiving inhaled corticosteroids by pressurised metered-dose inhaler (pMDI) or breath-actuated MDI. In parallel, the relationships between inhaler technique, adherence, and asthma control, and their modulation one month after training were assessed.

Of 727 patients receiving training at pharmacies ($n = 123$), 61% were prescribed a pMDI; 35%, an Autohaler®; and 5%, an Easi-Breathe® inhaler. Poor asthma control (Asthma Control Questionnaire score ≥ 1.5) at baseline was significantly ($p < 0.05$) and independently associated with poor inhaler technique and poor self-reported adherence (Morisky score ≥ 3). The percentage of patients with optimal inhaler technique rose from 24% before to 79% after training ($p < 0.001$). Median training session length was 6 min. At 1 month, mean (SD) ACQ score had improved from a baseline score of 1.8 (1.2) to 1.4 (1.1), ($p < 0.001$). Importantly, greater change was observed in patients with improved inhaler technique versus those without. Similar results were observed for Morisky score.

Inhaler technique is associated with adherence and influences asthma control. Inhaler training by pharmacists is feasible and seams to improve inhaler technique, asthma control and adherence.

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Introduction

Bronchodilators and most asthma controller therapies such as inhaled corticosteroids (ICS) are delivered by inhalation. The inhaled route provides the advantage of direct delivery to the target organ, thus ideally maximising the desired effects and minimising potential adverse effects associated with systemic administration. These benefits, however, are accompanied by the drawbacks of inhaled therapy, in particular the challenges patients face in using their inhaler devices.[1] Frequent misuse of inhaler devices has been documented for patients prescribed metered-dose inhalers (MDIs) as well as those using dry powder inhalers (DPIs).[2–5]

Indeed, despite the availability of efficacious therapies, asthma control is often poor,[6,7] and improper use of inhaler devices is one of the many causes of poor control.[1,5,8,9] Asthma management guidelines recommend that patients be taught proper inhaler handling and technique and that inhaler technique be checked at each visit.[10,11] However, the provision of inhaler technique training remains irregular. This is acknowledged by physicians[3,12] and corroborated in a recent patient survey.[13]

A simple verbal description of how to use an inhaler is not sufficient to guide patients on correct use of their inhalers, even the breath-actuated devices.[14] Instead, guidelines recommend that health-care providers demonstrate proper use as well as ask patients to demonstrate their inhaler technique.[11] Pharmacists are ideally positioned to teach inhaler technique as they are the last health-care providers to see patients before asthma medication is dispensed and are often in frequent patient contact.

The objectives of this study were to analyse, for patients with asthma receiving maintenance therapy with ICS administered through standard pressurised MDIs (pMDIs) or breath-actuated MDIs (BAIs):

(i) The feasibility and acceptability of education on inhaler technique in community pharmacies
(ii) Whether there is a link between inhaler technique, asthma control, and self-reported adherence. The short-term effects of education by pharmacists on inhaler technique, asthma control, and adherence to treatment were assessed. Changes in asthma control and adherence were compared between patients with versus without improved inhaler technique.

Methods

This prospective observational study was conducted from September to December 2008 in partnership with a group of pharmacies, PHR, throughout France. The study medical team provided a 2-hour training session at each pharmacy to teach basic asthma treatment principles, correct use of each of the studied inhaler devices, use of the study checklists to evaluate inhaler technique, and development of individualised instructions for each patient.

Participating pharmacies were asked to enrol the first 10 adult patients (≥18 years of age) with asthma who received a prescription for ICS delivered by pMDI or one of two types of BAI, the Autohaler® inhaler device (Teva Santé, Paris, France) or the Easi-Breathe® inhaler (Teva Santé, Paris, France).

Patients completed a questionnaire regarding prior inhaler training, asthma control, and self-reported adherence to prescribed medication. To assess prior inhaler training, patients were asked if they had been shown how to use their inhaler and if they had demonstrated their inhaler technique for a health-care professional. Asthma control was quantified using a shortened version of the Asthma Control Questionnaire (ACQ) without lung function testing (the ACQ6).[15,16] The ACQ6 score is the mean response to 6 questions (scored from 0, total control, to 6, severe lack of control), and the cut-point for poor asthma control is 1.5.[17] Self-reported adherence was quantified by the four-item questionnaire developed by Morisky et al.,[18] scored from 0, very good adherence, to 4, very poor adherence.

Pharmacists evaluated patients' inhaler technique, using specific check-lists for each study inhaler device type, both before and after providing training in inhaler use. For each patient, they recorded the number of attempts at using the inhaler and the length of education time required before obtaining adequate inhaler technique. At the end of the training session, the pharmacist completed written instructions for the patient, personalised according to observed inhaler technique and the errors that had been identified. The instructions were provided as a self-stick form that could be attached to the inhaler device.

In addition, patients were given a second questionnaire, with instructions for completion 1 month later, regarding their opinion as to the usefulness of training and the personalised instructions for inhaler use; asthma control and self-reported adherence were also reassessed. Patients were provided with a stamped, pre-addressed envelope for the return of the 1-month questionnaire by post.

The study was approved by the National Committee on Informatics and Liberty.

Assessment of inhaler technique

Pharmacists evaluated inhaler technique using a check-list adapted for each inhaler device. Optimal technique was defined as successful execution of each step on the check-list without errors. For the purpose of the analysis, critical errors were defined, per Molimard et al.,[3] as errors that could substantially affect dose delivery to the lung. For all inhaler devices, these included faulty preparation of the device such that no dose could be delivered; lack of inhalation across the inhaler; lack of exhalation before inhalation; too short or too fast inhalation; inhalation via the nose; and stopping inhalation after releasing the dose. In addition, for pMDIs, critical errors included actuating the dose at the end of the inhalation. Pharmacists were not aware of the distinction between critical and non-critical errors.

Statistical analyses

Descriptive statistics were used to summarise outcome variables. Quantitative variables were compared with

analysis of variance and qualitative variables with the χ^2 test. In addition, stepwise logistic regression was performed to identify factors independently associated with asthma control. Finally, changes between inclusion and follow-up were assessed using the paired *t* test for continuous variables and McNemar test for categorical variables. The statistical software used was SAS version 9.2, and a *p*-value of <0.05 was used to denote statistical significance.

Results

Pharmacies and patients

Of 300 pharmacies solicited, 256 participated in the training program, and 123 enrolled at least one patient. A total of 727 patients were included and received inhaler technique training from a pharmacist; of these, 503 (69.2%) returned the 1-month follow-up questionnaire. There were no statistically significant differences in age, sex, prescribed inhaler device, inhaler technique, ACQ score, or self-reported adherence between patients who did ($n = 503$) versus did not ($n = 224$) complete the 1-month questionnaire (data not shown).

The majority of the 727 patients who received a pharmacy training session were prescribed a pMDI (61%); one third, an Autohaler (34.5%); and a minority, an Easi-Breathe (4.5%). Patient characteristics by prescribed inhaler type are summarized in Table 1. Overall, the mean (SD) age of the 727 participating patients was 52 (19) years; 47% were men; and 58% were smokers or former smokers. The prescription was for a first inhaled therapy for 13.5% of patients, a new inhaler device for 21.2%, and renewal of previous treatment for the remaining patients.

Inhaler technique, previous education, asthma control, and self-reported adherence to treatment before training session

Before the pharmacy training session, one quarter of patients overall (24.1%) demonstrated an optimal technique, and 30% did not make any critical error. Tables 2 and 3 present the check-list results for each inhaler type before and after the training session. There were no differences with regard to inhaler type.

Overall, 67% of patients had been shown how to use their inhaler by a health-care professional, most commonly a respiratory physician, general practitioner, or pharmacist. But only one third (250/715; 35%) had demonstrated their inhaler technique to a health-care professional, most commonly a respiratory physician or general practitioner. Moreover, only 6 of 72 (8.3%) patients receiving their first inhaler prescription and 17 of 110 (15.5%) receiving a new type of inhaler had demonstrated their inhaler technique to a health-care professional.

At the time of the prescription, the mean ACQ (SD) score was 1.7 (1.2). For 368 patients (50.6%) the score was ≥ 1.5, indicating poor asthma control. Mean (SD) self-reported adherence to treatment was 1.3 (1.3). Both ACQ and self-reported adherence were higher (worse) when inhaler technique was not optimal: with ACQ score of 1.9 (1.2) versus 1.4 (1.1), ($p < 0.001$) and Morisky score of 1.4 (1.3) versus 1.1 (1.2), ($p < 0.01$), respectively.

Previous education that included demonstration of inhaler technique by the patient for a health-care professional was associated with better inhaler technique, asthma control, and reported adherence than no education or education limited to demonstration by the health-care professional (Table 4).

Using an ACQ score threshold of 1.5 or greater to define poor control,[17] logistic regression including age, sex, smoking status, inhaler device type, adherence, and inhaler technique identified poorer asthma control in patients with non-optimal inhaler technique, smokers, and patients with poor or very poor adherence (Table 5).

Feasibility and immediate efficacy of inhaler technique training at pharmacies

The percentage of patients judged by pharmacists to have optimal inhaler technique rose from 24% before to 79% after training ($p < 0.001$) (Fig. 1). The median duration of the training sessions was 6 min (range, 1—30 min) and a median of 2 (range, 1—10) handling attempts were made before an adequate inhaler technique was obtained. Over half of patients (444/704; 63%) received their training session in a room separate from other customers. There were no significant differences among inhaler device types for duration of training or number of handling attempts.

The inhaler training was well accepted by patients. Two thirds of patients (67%) judged the training to be useful or

Table 1 Demographic and asthma-related characteristics of 727 patients who received inhaler technique training by community pharmacists.

Characteristic	MDI, $n = 443$ (60.9%)		Autohaler, $n = 251$ (34.5%)		Easi-Breathe, $n = 33$ (4.5%)	
	n		*n*		*n*	
Age (yr), mean (SD) (range)	438	51.8 (18.4) (18—94)	245	53.5 (19.1) (18—88)	32	53.3 (19.3) (18—95)
Male sex, *n* (%)	439	201 (45.8)	247	120 (48.6)	32	14 (43.8)
Current smoker, *n* (%)	441	129 (29.3)	248	60 (24.2)	33	6 (18.2)
Current or ex-smoker, *n* (%)	368	208 (56.5)	215	129 (60.0)	31	19 (61.3)
First prescription of inhaled therapy, *n* (%)	309	42 (13.6)	202	28 (13.9)	30	3 (10.0)
New inhaler device type, *n* (%)	305	51 (16.7)	199	54 (27.1)	30	8 (26.7)

Table 2 A comparison of study check-list results before and after training by pharmacists in use of a pressurised metered dose inhaler.

Study check-list	Correct technique* ($n = 443$)	
	Before training	After training
Procedural steps to be followed		
1. Remove/open the cap[a]	418 (94.4)	431 (97.3)
2. Hold inhaler upright[a]	383 (86.5)	432 (97.5)
3. Breathe out gently[a]	260 (58.7)	420 (94.8)
4. Put mouthpiece in mouth and close lips[a]	358 (80.8)	436 (98.4)
5. Breathe in slowly and deeply[a]	228 (51.5)	419 (94.6)
6. Actuate at beginning of inhalation[a]	281 (63.4)	402 (90.7)
7. Maintain breath hold for 5 seconds.	232 (52.4)	416 (93.9)
Possible errors to avoid		
1. Inhaling through the nose[a]	400 (90.3)	442 (99.8)
2. Actuating inhaler at end of inhalation[a]	380 (85.8)	437 (98.6)
3. Taking more than one puff	363 (81.9)	440 (99.3)
4. No inhalation[a]	373 (84.2)	434 (98.0)
5. Breathing stopped at actuation[a]	347 (78.3)	440 (99.3)
Optimal technique	113 (25.5)	243 (79.3)

Data are presented as *n* (%).
*$p < 0.001$ (McNemar test) for all comparisons between before and after training.
[a] Critical error.

very useful. The majority rated the session as not inconvenient (81%) or minimally inconvenient (15%). The personalized self-stick instruction form was kept by 76% of the patients but it was judged useless or of little use by 50% of the patients.

Asthma control and adherence to treatment 1 month after training

On the 1-month questionnaire, the mean (SD) ACQ score had improved significantly relative to the starting score

Table 3 A comparison of study check-list results before and after training by pharmacists in use of the Autohaler® and Easi-Breathe® inhaler devices.

	Correct technique for Autohaler®* ($n = 251$)		Correct technique for Easi-Breathe®** ($n = 33$)	
	Before training	After training	Before training	After training
Procedural steps to be followed				
1. Remove/open the cap[a]	225 (89.6)	248 (98.8)	30 (90.9)	33 (100)
2. Hold inhaler upright[a]	207 (82.5)	245 (97.6)	25 (75.8)	32 (97.0)
3. Raise the lever to the vertical position[a]	198 (78.9)	240 (95.6)	—	—
4. Breathe out gently[a]	147 (58.6)	244 (97.2)	18 (54.5)	32 (97.0)
5. Put mouthpiece in mouth and close lips[a]	196 (78.1)	251 (100)	26 (78.8)	32 (97.0)
6. Breathe in slowly and deeply[a]	138 (55.0)	242 (96.4)	16 (48.5)	33 (100)
7. Maintain breath hold for 5 s	115 (45.8)	251 (100)	13 (39.4)	32 (97.0)
Possible errors to avoid				
1. Inhaling through the nose[a]	226 (90.0)	250 (99.6)	29 (87.9)	32 (97.0)
2. No inhalation[a]	221 (88.0)	250 (99.6)	29 (87.9)	33 (100)
3. Stop breathing at actuation[a]	193 (76.9)	249 (99.2)	23 (69.7)	33 (100)
4. Put lever down before inhalation[a]	235 (93.6)	249 (99.2)	—	—
5. Push the languette manually	242 (96.4)	251 (100)	—	—
Optimal technique	57 (22.7)	195 (77.7)	6 (18.2)	29 (87.9)

Data are presented as *n* (%).
*$p \leq 0.003$ (McNemar test) for all comparisons between before and after training.
**$p < 0.05$ (McNemar test) for all comparisons between before and after training except procedural step #1 and error #1 ($p = 0.08$ for both).
[a] Critical error.

Table 4 Relationship between previous education and inhaler technique, asthma control and adherence to treatment, as reported before training.

	Previous education on inhaler technique		
	No education	Demonstration by HCP; no demonstration by patient to HCP	Education including demonstration by patient to HCP
Optimal inhaler technique	10.5% ($n = 23/219$)	21.9%[b] ($n = 53/242$)	39.0%[b,c] ($n = 96/246$)
Mean (SD) ACQ score[16]	2.0 (1.1) ($n = 195$)	1.7 (1.1)[a] ($n = 234$)	1.6 ± 1.3[b,e] ($n = 238$)
Morisky score[18]	1.6 (1.4) ($n = 185$)	1.4 (1.3)[a] ($n = 226$)	1.1 (1.2)[b,d] ($n = 236$)

HCP, health-care professional.
[a] $p < 0.05$ versus no education.
[b] $p < 0.01$ versus no education.
[c] $p < 0.01$ versus education without demonstration by patient to HCP.
[d] $p < 0.05$ versus education without demonstration by patient to HCP.
[e] NS versus education without demonstration by patient to HCP.

from 1.8 (1.2) to 1.4 (1.1) ($p < 0.001$; $n = 437$). In addition, the mean self-reported adherence to treatment improved significantly from 1.4 (1.3) to 1.1 (1.3) ($p < 0.001$; $n = 436$), with the percentage of patients reporting moderate to very good adherence (score of 0 or 1) increasing from 58.0% to 66.2%.

The mean (SD) improvement in ACQ score for patients whose inhaler technique became optimal after training by the pharmacist was −0.4 (0.8), significantly greater ($p < 0.01$) than the ACQ score improvement for patients whose technique remained non-optimal (−0.2 [0.8]) or stayed optimal (−0.2 [0.9]). Similarly, the improvement in Morisky score was significantly greater ($p < 0.001$) for patients whose inhaler technique became optimal after training by the pharmacist (−0.4 [1.1]) compared with those whose technique remained non-optimal (−0.3 [1.1]) or stayed optimal (0.1 [1.1]).

In the subgroup of patients receiving renewed prescriptions for previous ICS ($n = 414$), the improvement in ACQ score was also significantly greater ($p < 0.05$) for patients whose inhaler technique became optimal after training by the pharmacist (−0.4 [0.8]) compared with those whose technique remained non-optimal (−0.1 [0.9]) or stayed optimal (−0.2 [0.9]). However in this subgroup, there was no difference according to inhaler technique improvement for change in Morisky score.

Discussion

Inhaler training that includes patients demonstrating inhaler technique for their physicians is not yet conducted in everyday practice, and only one quarter of patients in this study showed optimal inhaler technique before the pharmacy training session. Patients who showed incorrect inhaler technique had nearly two times higher odds for poor asthma control as defined by an ACQ score ≥1.5. The educational intervention by pharmacists resulted in improved inhaler technique at the end of the session and, at 1 month, improved asthma control and self-reported adherence to prescribed treatment. Our findings suggest that this type of patient training by pharmacists is feasible in everyday practice.

Table 5 Logistic regression: odds for poor asthma control at baseline (before inhaler technique training) defined as ACQ score ≥1.5[17] (bimodal test).

	Odds ratio	95% CI	*p*-Value
Age ≥55 years (vs. <55 years old)	1.20	0.86—1.68	0.28
Female sex (vs. male)	1.05	0.76—1.45	0.77
Inhaler device type			
Autohaler® (vs pMDI)	0.78	0.56—1.10	0.15
Easi-Breathe® (vs pMDI)	0.51	0.24—1.09	0.082
Smoker (vs. non-smoker)	1.53	1.05—2.22	0.026
Adherence[a] poor or very poor (vs. moderate or very good)	1.68	1.21—2.33	0.002
Pre-training inhaler technique non-optimal (vs. optimal)	1.89	1.31—2.75	0.0008

pMDI, pressurised metered-dose inhaler.
[a] Self-reported adherence according to Morisky questionnaire.[18]

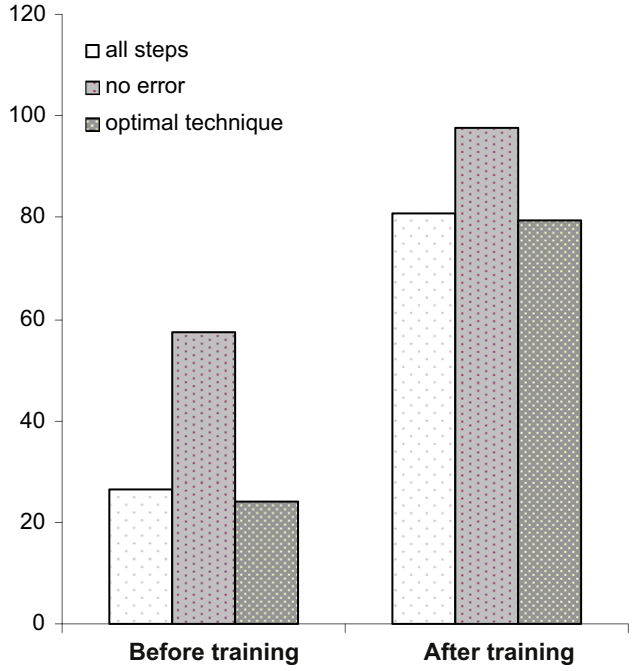

Fig. 1 Results of the inhaler technique training sessions: percentage of patients who successfully followed all procedural steps and committed no error and therefore had optimal technique before and after the inhaler technique training session ($n = 727$).

Inhaler training and its relationship with inhaler technique and asthma outcomes

Demonstration by patients of inhaler technique for a health-care professional who can then provide individualised instruction should be considered the minimal necessary inhaler training. However, in this study, two of three patients overall, and over 90% with a first inhaler prescription, had not had this opportunity. The question thus arises: how does one incorporate this approach, seemingly simple and rapid, into everyday practice? Training of all health-care providers is necessary, in addition to making available both placebo and disposable mouthpieces.

The training provided by pharmacists in the present study was of relatively short duration and appears to be compatible with everyday practice. Moreover, the training method was useful for both pMDIs and the two BAI devices. Nonetheless, without an objective measure of the inhalation manoeuvre, it is possible that patients' post-training inhaler technique was overestimated, particularly that for pMDIs, which require coordination of actuation and inhalation. Indeed, the findings of an English study that used the Aerosol Inhalation Monitor (AIM, Vitalograph), which measures inspiratory flow and can confirm coordination of actuation and inhalation, indicate that more than half of patients, despite repeated training, are unable to master correct pMDI technique.[19]

The association of poor pMDI technique with uncontrolled asthma, exacerbations, and need for oral corticosteroid therapy has been reported[20,21]; however, this is the first study investigating other inhaler devices. For these, the association remains strong after adjustment for other factors known to be associated with poor asthma control, including smoking and adherence. Thus, it is crucial to choose an inhaler device appropriate for each individual patient.[22]

Role of pharmacists

Asthma guidelines recommend that inhaler training should be repeated and that all health-care professionals should participate.[11] Pharmacists are particularly well placed for this role, as they are the last health-care providers with patient contact before dispensed asthma medication is used, and they have more frequent contacts with patients than doctors. Indeed, the role of pharmacists in providing patient education about asthma and inhaler technique is considered to be an important element in the success of the Finnish program in improving asthma control.[23] Thus, the French Health Authorities are planning to provide all pharmacies with instruction leaflets for each inhaler type to encourage pharmacists to educate patients.

Nonetheless, the role of pharmacists in improving asthma outcomes remains to be formally studied, as prior programs and outcomes analysed are inconsistent.[24] Armour and coworkers[25] report the success of a complex intervention targeted to patients with poor asthma control by remunerated pharmacists that encompassed patient education on asthma, elimination of trigger factors, treatment, adherence, inhaler technique training, and referral to a physician if warranted. Success of the intervention was measureable in terms of improved asthma control and adherence with controller therapy. Similarly, a less complex intervention centred on adherence and inhaler training was shown to improve inhaler technique and asthma control for patients with poor control, as evaluated using the Asthma Control Test.[26] Of note, even a simple intervention of inhaler technique training has been shown to improve inhaler technique and asthma control.[27,28]

Study limitations

Pharmacy setting may reduce potential biases that could result from physicians surveying their own patients. However, this observational study has several limitations, including the lack of randomisation and a short period of observation. Indeed, the short duration of follow-up (1 month) makes it mandatory to confirm the positive impact of inhaler training on asthma control and adherence over a longer period of observation.

Nonetheless, results are strengthened by the observation that ACQ and self-reported adherence improved more in patients whose inhaler technique improved after training, suggesting its efficacy. Similarly, in the subgroup of patients already receiving maintenance treatment before inclusion in the study, ACQ decreased only in those with improved inhaler technique.

In this study only patients treated with MDI or breath actuated MDI were studied; therefore, results cannot be extrapolated to others devices. However, Basheti and coworkers showed similar results for patients treated with dry powder inhalers.[27,28]

Assessment of control and adherence was performed via a postal questionnaire, but the response rate was adequate (63%), and there was no demographic or asthma-related difference identified between patients who did and did not respond to the questionnaire.

In addition, the self-reported adherence measure used is not specific to asthma controller therapy.[18]

Future research needs

Several questions remain for future evaluation. Will the positive short-term impact of inhaler training on asthma control and adherence be confirmed in a long-term follow up? Is one training session enough? A loss of initial skill has been shown as early as one month after training for pMDI. Repeated training is probably necessary and each contact with health care professionals should be used to reinforce initial education. Will participating pharmacists be able to continue to evaluate and train all patients in every day practice? Basheti et al.[29] report that pharmacists who are involved in continued patient training appear to be able to better maintain their inhaler technique demonstration skills. As a practical matter, it might be necessary to define which patients are most likely to benefit from inhaler technique training. High use of short-acting bronchodilator has been suggested as a marker of poor asthma control that is easy for pharmacists to assess.[30] We believe that a beneficial approach would be to formulate a framework—including training, participation in a network, and possibly remuneration—with a defined role for pharmacists in asthma training, similar to what has been suggested in other areas such as diabetes, fighting tobacco addiction, and contraception.

In conclusion, this assessment of inhaler technique in the pharmacy indicates that three quarters of patients do not have optimal technique and that prior inhaler training, particularly with regard to individualised assessment and guidance remains insufficient. Poor inhaler technique is significantly associated with poor asthma control, even after statistical adjustment for age, smoking, inhaler device type, and self-reported adherence. Inhaler technique training as provided by pharmacists appears to be feasible within everyday practice and improves inhaler technique. The accompanying increases in asthma control and self-reported adherence at one month should be confirmed in longer studies. For asthma, as for other conditions, the scope and practical application of patient training by pharmacists remains to be defined.

Conflict of interest statement

Violaine Giraud has been a part time employee of Teva Sante France until July 2010 and travel to the ERS congress was funded by Teva Sante France.

In the past 5 years, Nicolas Roche received fees for conducting research, speaking, organising education, attending meetings or consulting from Altana Pharma - Nycomed, AstraZeneca, Boehringer Ingelheim, Chiesi, GlaxoSmithKline, MEDA, Mundipharma, Novartis, Pfizer and Teva.

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References

1. Virchow JC, Crompton GK, Dal Negro R, et al. Importance of inhaler devices in the management of airway disease. *Respir Med* 2008;**102**:10—9.
2. Liard R, Zureik M, Aubier M, Korobaeff M, Henry C, Neukirch F. Misuse of pressurized metered dose inhalers by asthmatic patients treated in French private practice. *Rev Epidemiol Sante Publique* 1995;**43**:242—9.
3. Molimard M, Raherison C, Lignot S, Depont F, Abouelfath A, Moore N. Assessment of handling of inhaler devices in real life: an observational study in 3811 patients in primary care. *J Aerosol Med* 2003;**16**:249—54.
4. Cochrane MG, Bala MV, Downs KE, Mauskopf J, Ben-Joseph RH. Inhaled corticosteroids for asthma therapy: patient compliance, devices, and inhalation technique. *Chest* 2000;**117**: 542—50.
5. Molimard M, Le Gros V. Impact of patient-related factors on asthma control. *J Asthma* 2008;**45**:109—13.
6. Chapman KR, Boulet LP, Rea RM, Franssen E. Suboptimal asthma control: prevalence, detection and consequences in general practice. *Eur Respir J* 2008;**31**:320—5.
7. Rabe KF, Vermeire PA, Soriano JB, Maier WC. Clinical management of asthma in 1999: the Asthma Insights and Reality in Europe (AIRE) study. *Eur Respir J* 2000;**16**:802—7.
8. Crompton GK, Barnes PJ, Broeders M, et al. The need to improve inhalation technique in Europe: a report from the Aerosol Drug Management Improvement Team. *Respir Med* 2006;**100**:1479—94.
9. Dekhuijzen PR, Magnan A, Kneussl M. The ADMIT series — issues in inhalation therapy. (1) The goals of asthma treatment: can they be achieved? *Prim Care Respir J* 2007;**16**:341—8.
10. Global Initiative for Asthma (GINA). Global strategy for asthma management and prevention. Available from: http://www.ginasthma.org [updated 2009].
11. National Asthma Education and Prevention Program. Expert panel report 3: guidelines for the diagnosis and management of asthma; 2007. Available from: http://www.nhlbi.nih.gov/guidelines/asthma/asthgdln.pdf.
12. Giraud V, Allaert FA. Improved asthma control with breath-actuated pressurized metered dose inhaler (pMDI): the SYSTER survey. *Eur Rev Med Pharmacol Sci* 2009;**13**:323—30.
13. Giraud V, Allaert FA, Magnan A. Education to inhalation device technique, the case of Autohaler. 14e Congrès de Pneumologie de Langue Française, Marseille; 2010 Jan 29 to Feb 1 [Abstract].
14. Sestini P, Cappiello V, Aliani M, et al. Prescription bias and factors associated with improper use of inhalers. *J Aerosol Med* 2006;**19**:127—36.
15. 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**:902—7.
16. Juniper EF, Svensson K, Mork AC, Stahl E. Measurement properties and interpretation of three shortened versions of the asthma control questionnaire. *Respir Med* 2005;**99**: 553—8.
17. Juniper EF, Bousquet J, Abetz L, Bateman ED. Identifying 'well-controlled' and 'not well-controlled' asthma using the asthma control questionnaire. *Respir Med* 2006;**100**:616—21.

18. Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. *Med Care* 1986;**24**:67—74.
19. Hardwell A, Barber V, Hargadon T, Levy M. Technique training does not improve the ability of most patients to use pressurised Metered Dose Inhalers (pMDI). *Prim Care Respir J* 2009;**18**. A1. [Abstract].
20. Giraud V, Roche N. Misuse of corticosteroid metered-dose inhaler is associated with decreased asthma stability. *Eur Respir J* 2002;**19**:246—51.
21. McKnight E, Hardwell A, Levy M. Asthma control is influenced by patients' ability to use their pMDI. European respiratory society annual meeting, Barcelona; 18—22 September 2010 [Abstract P851].
22. Haughney J, Price D, Barnes NC, Virchow JC, Roche N, Chrystyn H. Choosing inhaler devices for people with asthma: current knowledge and outstanding research needs. *Respir Med* 2010;**104**:1237—45.
23. Haahtela T, Tuomisto LE, Pietinalho A, et al. A 10 year asthma programme in Finland: major change for the better. *Thorax* 2006;**61**:663—70.
24. Benavides S, Rodriguez JC, Maniscalco-Feichtl M. Pharmacist involvement in improving asthma outcomes in various healthcare settings: 1997 to present. *Ann Pharmacother* 2009; **43**:85—97.
25. Armour C, Bosnic-Anticevich S, Brillant M, et al. Pharmacy Asthma Care Program (PACP) improves outcomes for patients in the community. *Thorax* 2007;**62**:496—502.
26. Mehuys E, Van Bortel L, De Bolle L, et al. Effectiveness of pharmacist intervention for asthma control improvement. *Eur Respir J* 2008;**31**:790—9.
27. 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**:26—33.
28. Basheti IA, Reddel HK, Armour CL, Bosnic-Anticevich SZ. Improved asthma outcomes with a simple inhaler technique intervention by community pharmacists. *J Allergy Clin Immunol* 2007;**119**:1537—8.
29. Basheti IA, Armour CL, Reddel HK, Bosnic-Anticevich SZ. Long-term maintenance of pharmacists' inhaler technique demonstration skills. *Am J Pharm Educ* 2009;**73**(2). Article 32.
30. Bereznicki BJ, Peterson GM, Jackson SL, Walters EH, Fitzmaurice KD, Gee PR. Data-mining of medication records to improve asthma management. *Med J Aust* 2008;**189**: 21—5.