

DIAGNOSIS

Asthma management and inhalation techniques among community pharmacists in 2009: a comparison with the 1999 survey

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Abstract

Objective: In a 1999 survey, community pharmacists from the Alsace region of France had a reasonably good knowledge of asthma treatment and prevention, but their skill in the use of asthma inhalation devices left room for improvement. Since then, health authorities have encouraged the involvement of community pharmacists in patient care and education in order to improve asthma control. The aim of this study was to assess the change in the knowledge of asthma management and inhaler technique skills of community pharmacists in the same geographic area after a 10-year interval. **Methods:** In 2009, 86 randomly selected community pharmacists from the Alsace region answered a standardized questionnaire about their theoretical knowledge of and practical attitude toward asthma management and inhaled delivery systems, following which their skills in the use of four inhalation devices (pressurized metered-dose inhaler (pMDI) with/without a spacer, breath-actuated pMDI and dry powder inhaler (DPI)) were evaluated. **Results:** Very few pharmacists were required to manage an acute asthma exacerbation at the pharmacy, but all responded well by administering a short-acting inhaled β_2 -agonist. Theoretical knowledge of asthma management (criteria of severity of asthma exacerbation, guidelines and drugs triggering asthma exacerbations) was still average. Compared with 1999, they were twice as confident in demonstrating inhaler use, and their skills in using the pMDI, breath-actuated pMDI and DPI had improved significantly ($p < 0.001$). **Conclusions:** Since 1999, pharmacists' skill in the use of inhalers has improved, but theoretical knowledge of asthma management is still average, pointing to the importance of continuing pharmaceutical education.

Keywords

Continuing education, counseling, inhaled medication delivery system, pharmacist knowledge

History

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Introduction

Asthma is a serious public health issue in most countries because it is associated with high morbidity and mortality and a significant economic burden as well as affecting patients and families in their everyday life [1]. Despite the scientific advances that have improved our knowledge of asthma mechanisms and led to better management of the disease and to the availability of effective treatments, asthma control is still suboptimal [1]. This may, partly, be the result of the patient's lack of information about asthma and its treatment, poor treatment compliance or misuse of inhaled drugs [2].

In a systematic literature review, Cochrane et al. showed that patients took the prescribed dose of inhaled medication on 20–73% of days, and that the inhalation technique was effective in only 46–59% of patients [3]. To reduce the global burden of asthma, national and international health authorities published updated treatment recommendations and developed programs for asthma management and prevention in the period around 2000 [4–10]. Besides assessment and monitoring, the control of factors contributing to asthma severity and pharmacologic treatment, these guidelines stressed patient education as an essential part of asthma management. In particular, they encouraged asthma self-management education by all healthcare professionals interacting with asthmatic patients and involved in their education, i.e. general practitioners and specialists, nurses, pharmacists, physiotherapists, etc. [4–7].

Community pharmacists are especially well placed to perform this educational and counseling role because they are the last healthcare providers to see patients before they

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assume responsibility for the management of asthma themselves (i.e. self-administering inhaled medication and controlling their asthma), and they are often in frequent contact with patients. Through education and medication management, they can improve patient compliance and therefore asthma control [11–16].

Since pharmacists have a positive attitude toward asthma counseling, it seems essential that they should have sufficient knowledge of and skills in asthma management [17,18]. Studies evaluating pharmacists’ knowledge of asthma management, including criteria of severity, inhaler technique and prevention of exacerbations, are scarce [19–23]. In 1999, a survey that we carried out in a real-life setting among 120 community pharmacists of the Bas-Rhin *Département* (France) showed that community pharmacists had a reasonably good knowledge of asthma treatment and prevention, but their ability to use asthma inhalation devices left room for improvement [19].

In the last two decades, health authorities in many countries including France have encouraged the expansion of community pharmacists’ role in patient care and specifically their involvement in patient education or care programs for asthmatic patients [24]. Meanwhile, since the end of the 1990s, teaching pharmacies have been developed in French faculties, including Strasbourg in 2004, to create learning environments for initiation into community pharmacy practice. Thus, during workshops, students are invited to act out their future role in monitoring patients with chronic diseases such as asthma, and therefore to manipulate inhalation devices. This study therefore is intended to assess the change in asthma management knowledge and skills of community pharmacists in the French *Département* of the Bas-Rhin after a 10-year interval.

Methods

This survey was carried out in June 2009 under the auspices of the Chest Diseases Department of the Division of Pulmonology, Allergy and Environmental Respiratory Diseases at the University Hospital of Strasbourg, France. It was performed using the same methodology as that employed in the first survey carried out in 1999 [19]. The survey was approved by the Regional Council of the Guild of Pharmacists of the Alsace region.

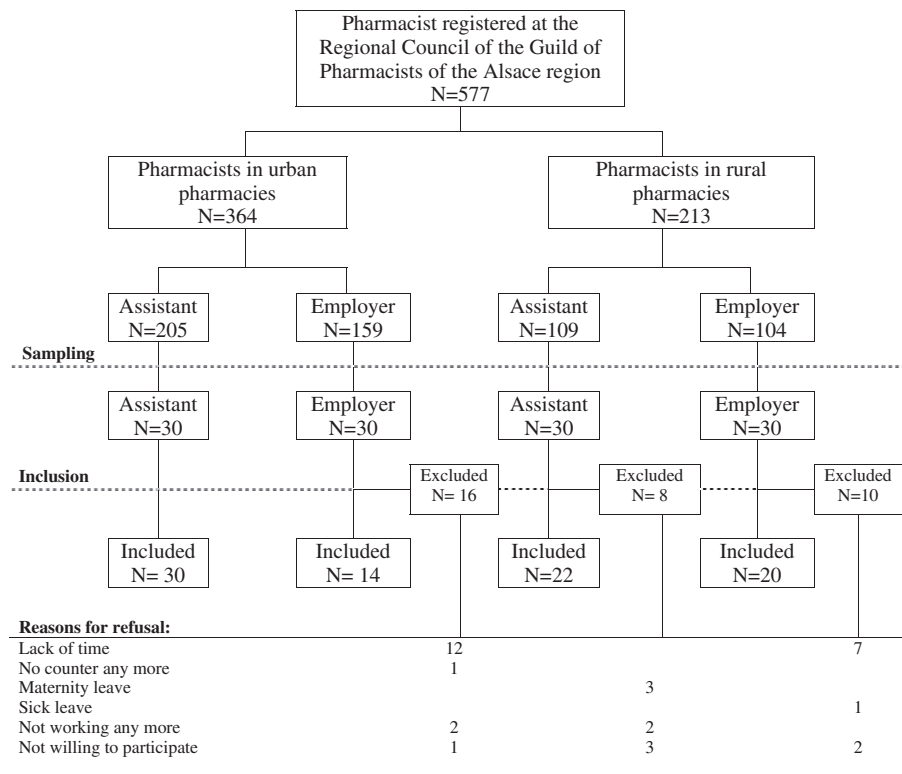
Selection of participants and study plan

Participants were recruited from among the 577 community pharmacists registered with the Regional Council of the Guild of Pharmacists of the Alsace region, including 263 employer pharmacists and 314 assistant/employee pharmacists. These two groups were divided into two categories according to their rural (area with <5000 inhabitants and only one pharmacy) or urban location (Figure 1). In each group, 30 participants were randomly selected to answer a standardized questionnaire. After having received a first mailshot, the 120 pharmacists were contacted by telephone to be informed of the objectives of the study. A meeting was arranged at the pharmacy for those who agreed to participate in the survey. A single trained investigator carried out the interviews and evaluated the correct use of the inhalation devices.

Questionnaire

The standardized questionnaire was similar to that used for the 1999 survey, with the exception of a few additional questions [19]. A copy of the full 2009 questionnaire is available on request from the corresponding author. It was compiled on the basis of the international guidelines and was

Figure 1. Participant flow chart.



based on the study by Kesten et al. for the assessment of pharmacists' inhaler technique [7,20]. The questionnaire consisted of four separate parts:

- The first part included demographic data.
- The second part consisted of 43 questions concerning the pharmacist's knowledge of and attitude to the management of an acute asthma attack (criteria of severity of asthma exacerbation, management of the attack and medication provided), his/her theoretical knowledge of and practical attitude toward asthma management (guidelines, medications potentially exacerbating asthma and prevention) and his/her attitude when dispensing an asthma medication.
- The third part comprised 13 questions about the knowledge of inhaled delivery systems (duration of inhalation, advantages of spacers, etc.)
- The last part was devoted to the evaluation of the pharmacist's ability to use four placebo inhaler devices: a pressurized metered-dose inhaler (pMDI), the same inhaler with a spacer device (Babyhaler®), a breath-actuated pMDI (Autohaler®) and a dry powder inhaler (Turbuhaler®). The investigator scored their performance according to the number of steps for each inhaler device, i.e. 12 for the pMDI and the Autohaler®, 11 for the Turbuhaler® and 8 for the Babyhaler®. For each inhaler, pharmacists refusing to perform a demonstration were deemed not to know how to use the device and were assigned a performance score of 0.

Statistical analysis

Statistical analysis was performed using SPSS® v.16 (Chicago, IL) and STATXACT software (Cytel Inc., Cambridge, MA). Qualitative data were described as percentages of yes/no answers, and scores for inhaler technique assessment as mean $\pm$ standard deviation. For questions with multiple items about criteria of severity of asthma exacerbation and asthma-exacerbating drugs, a performance score of 0 was assigned when pharmacists stated that they did not know the answer. For proportions, comparisons between the 1999 and 2009 surveys were performed using Pearson's χ^2 test or Fisher's exact test when the assumptions of the χ^2 test were not met (number of expected counts <5). For quantitative variables, Student's *t*-test was performed. The threshold of statistical significance was <0.05 .

Results

Population characteristics

The participant flow chart for the 2009 survey is depicted in Figure 1. Of the 120 pharmacists selected, 34 (28.3%) refused to participate. The main reason advanced by the pharmacists in 2009 for not participating in the survey was lack of time ($n=19/34$, 52.9%). Compared with the 1999 survey, the refusal rate in 2009 was exactly the same. The 2009 population therefore consisted of 86 community pharmacists. The characteristics of the 1999 and 2009 populations (Table 1) were comparable in terms of working environment ($p=0.936$), percentage of women ($p=0.121$) and pharmacy assistants ($p=0.168$).

Table 1. Characteristics of the 1999 and 2009 survey populations.

Characteristics	1999 population <i>N</i> = 86	2009 population <i>N</i> = 86
Age (mean $\pm$ SD), years	40.7 $\pm$ 9.4	40.1 $\pm$ 9.9
Sex, <i>n</i> (%)		
Female	46 (53.5)	56 (65.1)
Male	40 (47.5)	30 (34.9)
Status, <i>n</i> (%)		
Assistant	43 (50.0)	52 (60.5)
Employer	43 (50.0)	34 (39.5)
Environment, <i>n</i> (%)		
Rural	45 (52.3)	45 (52.3)
Urban	41 (47.7)	41 (47.7)
Seniority (date of thesis defense <median)		
Median date of thesis defense	1983	1998
Assistant, <i>n</i> (%) of assistants	11 (25.6)	23 (44.2)
Employer, <i>n</i> (%) of employers	32 (74.4)	20 (58.8)

Comparisons were performed using the χ^2 test; no statistical difference was observed between the two populations.

Knowledge of and attitude to the management of an acute asthma attack

In both 1999 and 2009, a small number of pharmacists [9 (10.5%) and 7 (8.1%), respectively] were required to manage an acute asthma exacerbation in a patient at the pharmacy in the previous 12 months, and all of them administered a short-acting inhaled β_2 -agonist. In both surveys, none contacted the emergency medical services. However, two pharmacists in 2009 advised the patient to consult their doctor versus nine in 1999 (28.6% versus 100%), two others called the patient's referring physician versus 1 in 1999 and four advised the patient to return home versus 3 in 1999 (57.1% versus 33.3%).

In terms of the knowledge of the six criteria characterizing a severe asthma exacerbation, i.e. difficulty speaking in complete sentences, agitation, respiratory rate >30 /min, cyanosis, difficulty with coughing, sweating, 14 of the 86 pharmacists (16.3%) in 1999 and 12 (14%) in 2009 knew all six criteria. However, 57.0% and 62.8%, respectively, were able to mention at least four criteria. The criteria most frequently mentioned in both 1999 and 2009 were respiratory rate and cyanosis (Figure 2).

Knowledge of and practical attitude toward asthma management

Knowledge of the Global Initiative for Asthma (GINA) international guidelines for asthma management was significantly lower in 2009 than in 1999 ($p<0.001$) [8]. In 2009, only one pharmacist (1.2%) had been told of these guidelines without knowing its content. By contrast, in 1999, 32.6% (28/86) were aware of this publication and 18.6% (16/86) were fully conversant with it. Nevertheless, 38.4% (33/86) of the 2009 pharmacists knew the French recommendations for the follow-up of adolescent and adult patients with asthma, published by the National Agency for Accreditation and Evaluation in Health (ANAES) in 2004, and 15.1% had some idea of their content [5].

In both 1999 and 2009, a large majority of the pharmacists (86% and 93%) knew at least one drug that exacerbated the symptoms of asthma. However, in 2009, significantly more

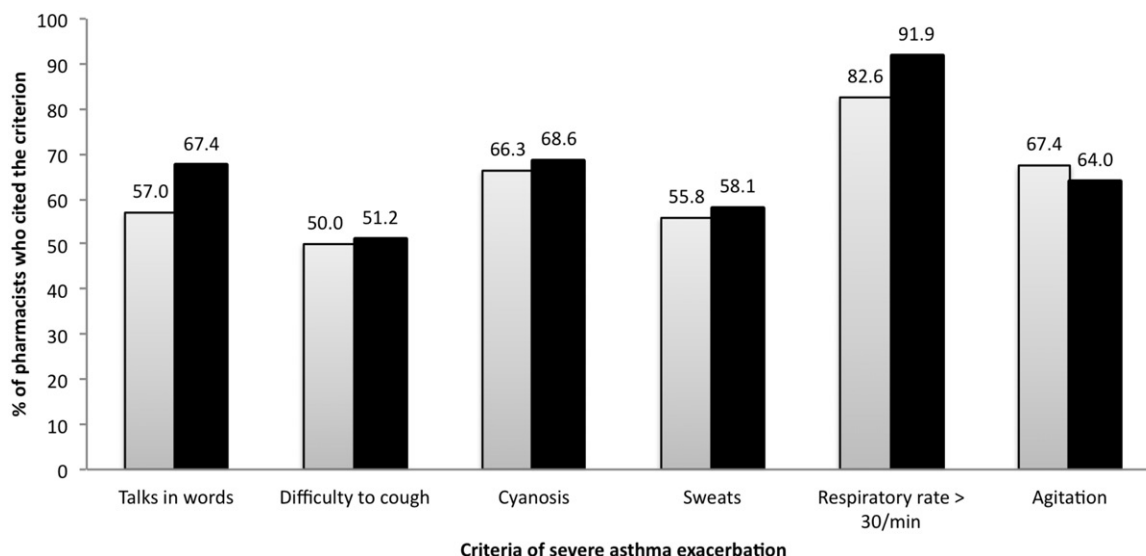


Figure 2. Knowledge of criteria for severe asthma exacerbation among pharmacists ($n=86$) interviewed in 1999 (gray bars) and 2009 (black bars). No statistically significant difference was observed between the two surveys (χ^2 test).

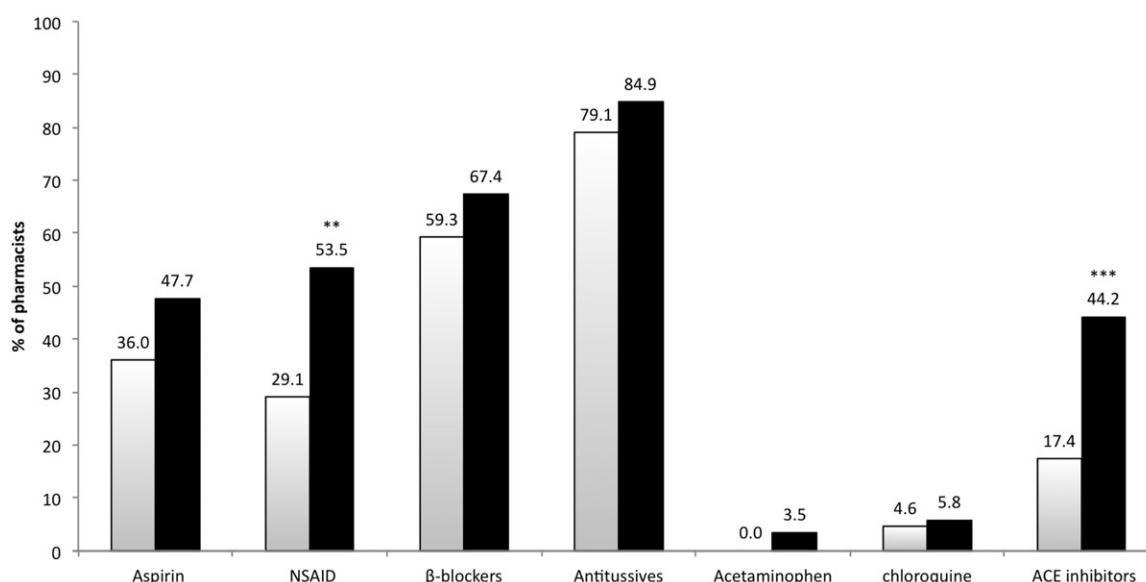


Figure 3. Knowledge of drugs triggering an exacerbation of asthma symptoms among the population of pharmacists ($n=86$) interviewed in 1999 (gray bars) and 2009 (black bars). Between-group comparison using the χ^2 test: ** $p<0.01$, *** $p<0.001$.

correctly named at least two causal drugs among a list of seven medications (51.2% versus 34.9%, $p=0.033$) and mentioned the four drugs known at that time to potentially exacerbate asthma symptoms (31.4% versus 15.1%, $p=0.013$), i.e. aspirin and other nonsteroidal antiinflammatory drugs (NSAID), antitussives and β -blockers (Figure 3). In particular, knowledge of NSAIDs as an exacerbating factor of asthma in sensitized patients was significantly increased in 2009 compared to 1999 (53.5% versus 29.1%, $p=0.002$).

When asked for an over-the-counter antitussive, nearly all pharmacists questioned the unknown patient about his/her cough (frequency, consistency and duration) in both surveys (Table 2). However, compared with 1999, a significantly higher number of pharmacists in 2009 also questioned the potential use of asthma medications and advised the patient to

consult a physician, whether the patient was a child or an adult ($p<0.001$ and $p=0.007$, respectively). Their practical attitude toward asthma management was also evaluated with respect to counseling on asthma trigger avoidance. Asthma prevention measures were fairly well known by pharmacists in both surveys (Table 2), but in 2009 they insisted significantly more on daily ventilation of bedrooms ($p=0.008$) and of the house ($p<0.001$) and less on the use of acaricides ($p=0.049$).

The presence of a private area specifically for the issue of medications and medical devices was similar in 2009 and 1999 (69.8% and 72.1%, respectively). The percentage of pharmacists willing to create such an area in unequipped pharmacies was slightly higher in 2009 than in 1999 (88.5% versus 66.6%, $p=0.066$). Furthermore, the great majority of pharmacists believed that they could play a role in asthma

Table 2. Practical attitude of pharmacists to asthma management in 1999 and 2009.

Request for an over-the-counter antitussive	Unknown adult patient		Unknown pediatric patient	
	1999	2009	1999	2009
Pharmacist's attitude				
Ask about cough	93.0	97.7	98.8	96.5
Ask about a potential asthma treatment	17.4	59.3 ^a	23.3	64.0 ^a
Dispense without comment	5.8	4.7	1.2	2.3
Advise consultation with a physician	0	9.3 ^b	0	12.8 ^a
Advice for allergic asthma of known origin	1999		2009	
Acaricide	82.6		69.8 ^c	
Dust mite-proof mattress covers	66.3		67.4	
Special floor coverings	66.3		59.3	
Daily ventilation of bedroom	79.1		93.0 ^b	
Daily ventilation of house	61.6		87.2 ^a	
No smoking	94.2		95.3	
Avoid smoke-filled rooms (passive smoking)	91.9		93.0	
Air conditioning use	8.1		8.1	
Keep windows and doors closed during pollen count peaks	51.2		51.2	

Numbers correspond to percentages of pharmacists.

Between-group comparison using the χ^2 test: ^a $p < 0.001$, ^b $p < 0.01$ and ^c $p < 0.05$.

screening in both 1999 and 2009 (81.4% and 90.7%, respectively).

Counseling during asthma medication dispensation

When dispensing medications to a patient with asthma, in both 1999 and 2009, the majority of pharmacists stressed the fundamental difference between asthma relief and asthma control (77.9% and 87.2%), commented on the prescription with the aim of improving patient compliance (95.3% and 96.5%) and explained the use of inhaler devices (96.5% and 94.2%) for a mean period of <15 min in 70.9% and 79% of cases. However, only 33.7% and 29.1% in 1999 and 2009, respectively, checked the patient's use of the inhaler device, although the number of pharmacists who had a placebo inhaler device for this purpose was significantly higher in 2009 than in 1999 (75.6% versus 27.9%, $p < 0.001$). When the pharmacists were presented with a prescription for an excessive dose of a β_2 -agonist, the majority called the prescriber in both 1999 and 2009 (67.4% and 75.6%), but significantly fewer warned their patient of this overdose in 2009 than in 1999 (47.7% versus 64%, $p = 0.030$). Conversely, only two pharmacists in 2009 versus nine in 1999 ($p = 0.030$) dispensed the medication without comment.

When the prescription was dispensed, patients most often asked the pharmacists for information about how to use the asthma inhaler device (87.5% and 96.5%), the doses of medication (81.4% and 72.1%) and the dosing intervals (81.4% and 68.6%), both in 1999 and in 2009; 51.2% of the patients in 1999 and 41.9% in 2009 asked the pharmacists for information on side effects and, respectively, 37.2% and 26.7% on drug interactions. Details on the mechanism of action, time to onset of action or action duration were

Table 3. Comparison of theoretical knowledge of inhaled medication delivery systems in 1999 and 2009.

Pharmacists' knowledge	1999	2009
Advantages of spacers		
Reduces the risk of oral candidiasis by reducing oropharyngeal deposition of corticosteroids	60.5	45.3 ^a
High inspiratory flow rate not required for correct drug administration	89.5	95.3
Obviates the need for hand-lung coordination required when using an MDI	94.2	98.8
Use of other inhaler systems		
Rapid inspiration is not recommended when using a pMDI	86.0	80.2
Minimum respiratory flow rate required for DPI actuation	69.8	74.4
Excessively low respiratory flow rate leads to reduced drug penetration in the lungs with a DPI	76.7	88.4 ^b
Important to rinse the mouth or gargle after inhaled corticosteroid use	69.8	100 ^c

Numbers correspond to percentages of pharmacists; pMDI: pressurized metered-dose inhaler; DPI: dry powder inhaler.

Between-group comparison using the χ^2 test: ^a $p < 0.01$, ^b $p < 0.05$ and ^c $p < 0.001$.

requested by less than 40% of patients. Conversely, patients asked about the nature of the medication significantly less in 2009 than in 1999 (29.1% versus 53.5%, $p = 0.020$).

Knowledge of peak-flow meter and inhaled medication delivery systems

In both 1999 and 2009, a large majority of pharmacists knew the value of the peak flow meter in the self-assessment of patient's asthma control (76.7% and 89.5%, respectively), but in 2009 they had a better knowledge of its method of use (82.6% versus 67.4%, $p = 0.017$). All the pharmacists in 2009 and nearly all in 1999 recognized the value of the spacer in improving the administration of inhaled medications (100% and 98.8%) and knew its advantages (Table 3) and how to use it (100% and 96.5%). A larger number of pharmacists in 2009 than in 1999 recommended this device for use in young patients (91.9% versus 47.7% $p < 0.001$) and in the elderly (14.0% versus 7.0%, $p = 0.138$). In respect of the theoretical use of other inhaler systems, pharmacists' knowledge had improved generally in 2009 compared with 1999 (Table 3). Furthermore, all pharmacists pointed out the importance of rinsing the mouth or gargling after inhaled corticosteroid use, whereas only 69.8% gave this advice in 1999 ($p < 0.001$).

Assessment of inhaler technique

Compared with the 1999 survey, the number of pharmacists agreeing to be assessed on the use of each placebo inhaler in 2009 was more or less twice as high (Table 4). For the pMDI, Autohaler[®] and Turbuhaler[®], the proportion of pharmacists able to perform all the steps was low and similar in both surveys. Nevertheless, the mean performance scores for the three devices improved significantly between 1999 and 2009.

Overall, shaking the inhaler was the step most frequently forgotten in both surveys during the pMDI, Autohaler[®] and spacer demonstrations, but significantly less often in 2009

Table 4. Assessment of inhaled medication delivery technique in the 1999 and 2009 populations.

Inhaler type	Number of steps	% of participants (n ^a /N)		% of pharmacists validating all steps (n ^b /N)		Mean score $\pm$ SD [Median] (N = 86)	
		1999	2009	1999	2009	1999	2009
pMDI	12	63.9 (55/86)	98.8 ^a (85/86)	16.3 (14/86)	10.5 (9/86)	6.7 $\pm$ 5.2 [10]	9.7 $\pm$ 1.7 ^a [10]
Autohaler [®]	12	32.6 (28/86)	74.4 ^a (64/86)	4.7 (4/86)	5.8 (5/86)	3.0 $\pm$ 4.5 [0]	7.5 $\pm$ 4.6 ^a [10]
Turbuhaler [®]	11	46.5 (40/86)	97.7 ^a (84/86)	27.9 (24/86)	36.1 (31/86)	4.8 $\pm$ 5.2 [0]	10.0 $\pm$ 1.7 ^a [10]
Volumatic [®] /Babyhaler [®] (1999)/(2009)	9/8	58.1 (50/86)	98.8 ^a (85/86)	18.6 (16/86)	17.4 (15/86)	4.7 $\pm$ 4.1 [7]	6.6 $\pm$ 1.2 [7]

n^a Number of pharmacists performing the inhaler technique demonstration; n^b Number of pharmacists with proper inhalation technique (no error made); N total number of pharmacists.

Between-group comparison using the χ^2 test for proportions and Student's *t*-test for mean scores: ^a $p < 0.001$.

The investigator recorded the steps followed by the pharmacist in the use of each device and scored their performance according to the number of steps for each inhaler device. Pharmacists refusing to give a demonstration were considered not to know how to use the devices and were rated 0 for each step in the calculation of the mean score. Statistical comparison was performed using the χ^2 test. No comparison was performed for Volumatic[®] and Babyhaler[®] devices tested in 1999 and 2009, respectively, since their methods of use differed.

than in 1999 for the pMDI ($p = 0.01$) and Autohaler[®] ($p = 0.03$) (Figure 4). For the pMDI, step 3 (exhaling fully to empty the lungs) was nearly always performed compared with 1999 ($p < 0.001$). For the Autohaler[®], steps 10 and 11 were forgotten significantly less often in 2009 ($p = 0.01$ and $p < 0.001$). For the Turbuhaler[®], holding the breath for about 10 s was most often forgotten in 2009, as in 1999. By contrast, steps 3 and 4 were significantly less often forgotten in 2009 ($p < 0.001$ for both). As regards spacers, only 18.6% and 17.4% of pharmacists successfully demonstrated the use of the Volumatic[®] in 1999 and the Babyhaler[®] in 2009, respectively. Besides shaking the inhaler, the number of respiratory cycles (5–10 breaths) required for the inhalation of the correct dose of drug was most frequently forgotten, and only 53.5% of pharmacists remembered to perform this step.

In both 1999 and 2009, pharmacists' inhaler technique skills were mainly acquired by reading the instructions for use of the devices (75.0% and 90.7%) and other written documentation (63.0% and 39.5%). In 2009, 50% of pharmacists versus 24% in 1999 were also informed by other means of information, such as laboratory representatives or professional media. In both surveys, 88.4% of pharmacists said they attended continuing pharmaceutical education courses, regularly in about 48% of cases.

Discussion

Although community pharmacists need to be increasingly involved in the therapeutic education of patients with asthma, their knowledge of asthma management and inhaled medication delivery devices has rarely been evaluated outside pharmacist-provided education programs. To address this question and evaluate the change in pharmacists' attitude since the implementation of asthma management and prevention programs, the same questionnaire-based survey was carried at an interval of 10 years in a representative sample of pharmacists working in community pharmacies in the East of France [4–10]. In our first study in 1999, we showed that community pharmacists had a reasonably good knowledge of asthma management and its treatment, whereas their inhaler technique skills were poor [19]. In this study, we demonstrated that pharmacists' knowledge of asthma was

comparable, but that their inhaler technique skills had improved. Our study showed that, in both 1999 and 2009, very few patients attended the pharmacy with an acute asthma exacerbation, but all the pharmacists in 2009 managed the emergency very well by administering a short-acting inhaler β_2 -agonist to the patient. However, in contrast to the 1999 pharmacists who all referred the patient to a doctor, few (2/7) of the 2009 pharmacists gave this advice, although two others called the referring physician to inform him of the situation. Whether severe or not, the occurrence of an asthma exacerbation indicated that the patient's asthma was not well controlled. Therefore, in such situations, the pharmacist should contact the patient's referring doctor to inform him of his patient's condition. This initiative would allow a better follow-up of the patient and could thus lead to improved asthma control. In addition, this study shows pharmacists' poor knowledge of the criteria of severity of asthma exacerbation, which suggests that some of them may not have been aware of the potential gravity of an asthma attack and may not have regarded this situation as an emergency.

Although the great majority of community pharmacists wished to be involved in asthma management, in both 1999 and 2009, very few knew the French and international guidelines published around the year 2000 for the improvement of asthma management [1,5]. Similarly, although their knowledge of the drugs causing an exacerbation of asthma symptoms has increased significantly compared with 1999, there is still room for improvement. Although cardioselective beta-blockers have a proven benefit in the management of patients with asthma following myocardial infarction or with concomitant heart failure, noncardioselective beta-blockers may exacerbate bronchospasm [25]. In our study, we observed that beta-blocker drugs were the most well-known of the drugs that exacerbate asthma, about two-thirds of pharmacists mentioned this medication in 1999 and 2009, whereas aspirin and other nonsteroidal antiinflammatory drugs were mentioned in only about 50% of cases in 2009. Nevertheless, when dispensing NSAIDs over the counter, pharmacists should systematically enquire about the history of reactions to these drugs. This demonstrates a discrepancy between the lack of theoretical knowledge of asthma management and the positive attitude toward asthma counseling and the desire to

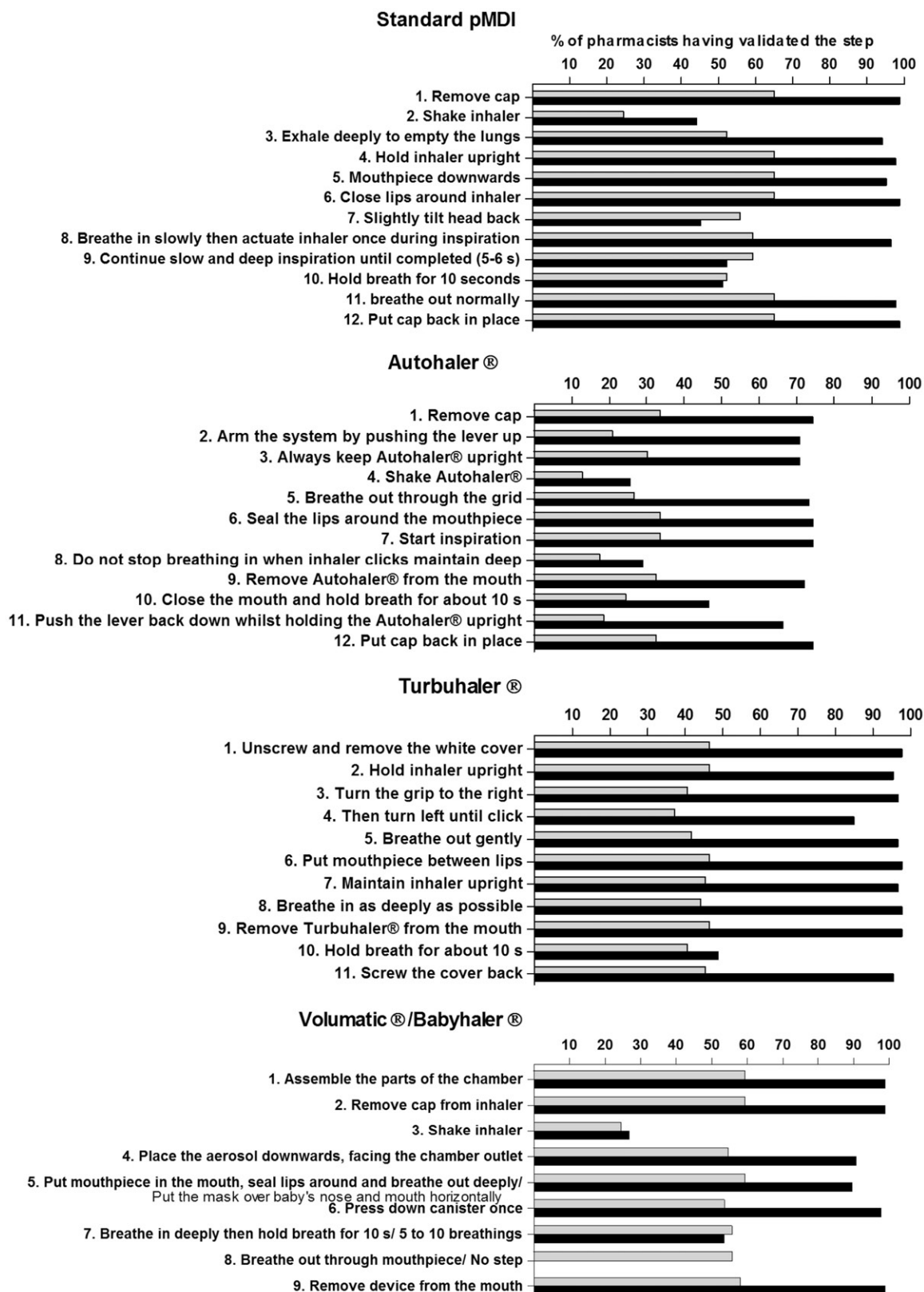


Figure 4. Evaluation of four inhalation systems in 1999 (gray bars) and 2009 (black bars).

act, as reported in two studies. In a national survey carried out in 250 pharmacists in Turkey, the pharmacists reported low levels of knowledge of asthma (52%) and a need for further education (80%), while 65% believed they had a vital role in asthma management [21]. In a Finnish study evaluating the effect of in-house training on the roles and skills of 315

community pharmacists in asthma management, most of the participants (>80%) considered that they had an important counseling role in the correct handling of inhalers and the implementation of the inhalation technique [18]. In addition, about 40% of pharmacists interviewed before the training perceived their own lack of knowledge and skills as the main

problem in asthma counseling. This shows the importance of the continuing pharmaceutical education of pharmacists in maintaining a good level of knowledge and in keeping them up to date in asthma management and inhalation technique. In our study, in both 1999 and 2009, only half of the pharmacists attended continuing pharmaceutical education courses regularly.

In contrast to their theoretical knowledge, pharmacists' general attitude to the management of asthma in our study had clearly improved in 2009 compared with 1999 based on the significant results observed concerning pharmacists' counseling when asked for an over-the-counter antitussive, information delivered on trigger avoidance and the mean performance scores of inhalation technique. When dispensing an antitussive to an unknown patient, pharmacists were significantly more aware that a patient with cough symptoms may be suffering from asthma and they questioned the potential use of asthma medications in patients presenting with cough. In addition, our results show that the majority of community pharmacists in 2009 strove to play their role in the therapeutic education of patients with asthma, although their intervention may not always have been optimal. They generally have a private area set aside for this type of intervention. When dispensing asthma medications, pharmacists usually put across the main educational messages by explaining the prescription, the need for good compliance for optimal efficacy of the treatment and the use of inhaler devices. Furthermore, they were well aware of the preventive measures for limiting exposure to asthma trigger factors. The mean prescription dispensing time is less than 15 min, which should be sufficient to demonstrate the inhaler technique, and thus help patients to control their asthma. However, a recent observational study carried out in 727 patients with asthma demonstrated that a 6-min median time for the training of patients in inhaler technique by pharmacists was sufficient to improve the efficacy of treatment and patients' asthma control [26]. This confirms the results from previous studies on the effectiveness of pharmacists' interventions in improving inhaler scores of patients with asthma [27,28]. This study also showed that only a third of patients had the inhaler technique demonstrated by a healthcare professional (usually a physician) before receiving training in the pharmacy [26]. Similar lack of patient training has been reported in previous studies: among 36 adolescents with asthma in rural Arkansas, 20% had never been shown the appropriate use of an MDI, and among 52 pharmacists, only 13% offered to educate the patient-investigator in an evaluation of pharmacists' practice carried out in the 1990s [29,30]. Similarly, only 30% of pharmacists in our study said that they checked the correct use of inhalers by the patient. This indicates that inhaler training, including checking the correct use of the device by the patient, is not yet routine in everyday practice, whether in the pharmacy or in the physician's office. In the literature, effectiveness of several methods of training has been evaluated. The instruction sheet on an inhaler package insert alone is definitely not sufficient. Improvement in inhaler scores has been obtained both with instructions given by a health professional, both by video and by telepharmacy counseling *via* interactive compressed video [31,29]. Nevertheless, it has been shown that the proportion of

patients exhibiting a correct technique after training by the pharmacist had decreased at follow-up (from 100% immediately after training to 61% one month later), which suggests that inhaler training must be repeated and all healthcare professionals should be involved [32]. A similar decline after training by healthcare professionals has also been observed in several studies, underlining the importance for pharmacists to keep their inhalation technique up to date [33,34]. Nevertheless, the provision of repeated inhaler technique training to patients would have beneficial consequences, both in improving patient's education and in maintaining pharmacists' inhaler technique skills, as was observed in a recent study [35].

Specifically in terms of inhalation technique and handling of inhaler devices, our study showed that pharmacists felt much more confident about their inhalation technique in 2009, since there were twice as many as in 1999 who agreed to demonstrate the method of use of inhalers, irrespective of the model. In the demonstration, this perception of a better knowledge was confirmed by a highly significant improvement in mean performance scores in 2009 compared with 1999 (+3 to +5 difference), although the proportion of pharmacists who validated all the steps did not increase and was relatively low. Similarly, low results for correct handling are also found in other studies evaluating the skills of healthcare professionals in the use of inhalation devices (for a review, see [36]). Failure to "shake the inhaler before use" was the most common problem with the pMDI, Autohaler® and spacer in both surveys, but was significantly less common in 2009 than in 1999. This problem had already been observed by Kesten et al. in 1993 [20]. In the case of suspensions, this critical error has been shown to reduce drug deposition in the lungs by up to 50%, and thus significantly decrease the efficacy of the treatment [37]. The other most common error was failure to hold the breath for a few seconds after inhalation. It is worth noting that these errors are also the most commonly observed in patients [38,39]. The community pharmacist should therefore be aware of these critical errors in order to warn the patient of the important steps and check periodically that they are performed correctly when dispensing an inhaler device. If a problem is then detected with a particular device, this strategy may lead the pharmacist to report the problem to the referring physician and suggest a change in the patient's inhaler device.

Patients' improper inhaler technique, among other factors including noncompliance, ignorance of guidelines, poor follow-up or inadequate use of corticosteroids, has been identified as being associated with poor outcomes in patients with asthma. Several studies have investigated pharmacists' impact on clinical outcomes (for a review, see [11]). Thus, an enhanced intervention provided by specially trained pharmacists has shown improvement in pulmonary function [40,41], asthma severity [41,14], drug utilization [42,43] and quality of life [14,40]. Accordingly, those studies emphasize on the possible role of specifically trained community pharmacists in assisting patients to achieve asthma control by providing them with suitable information and training about asthma medication, basic concepts of the disease, trigger identification and avoidance, by instructing correct inhalation technique and by assessing knowledge. In our study, pharmacists' skill in the

use of inhalers has improved, but theoretical knowledge of asthma management has remained average since 1999, pointing out the importance of continuing pharmaceutical education.

There are limitations to our survey. One may be that pharmacists' skills in handling inhaler devices were rated by only one investigator, who may have made a subjective judgment of the quality of performance of the steps. Secondly, we scored 0 for pharmacists who refused to participate in the demonstration, which underestimates the performance of the population of pharmacists in 1999, since only half of them agreed to participate in the demonstration.

Conclusion

Overall, our results show that pharmacists had better inhaler technique skills in 2009 than in 1999, and the majority had a good theoretical knowledge of asthma medications, prevention advice and drug inhalation systems and provided effective counseling in asthma management to patients at the counter. However, they still need to improve their theoretical knowledge of the management of asthma (criteria of severity of asthma exacerbation, guidelines and drugs exacerbating asthma symptoms) and inhaler use. Continuing pharmaceutical education, which has been compulsory in France for community pharmacists since 1 January 2012, has been shown to be effective for healthcare practitioners in France and other countries in improving their attitude toward and knowledge of asthma [44–46]. Taking into account their increasing role, in particular, in the regular reassessment of patients' inhaler technique, continuing pharmaceutical education may also increase pharmacists' involvement in the education of patients with asthma and thus improve patients' skills in handling inhaler devices and asthma control.

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Declaration of interest

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