

National electronic Library for Medicines

Medicines Management Overview

August 2012

INHALER USE TECHNIQUE AND RELATED INTERVENTIONS An annotated bibliography

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Summary

This annotated bibliography with 194 references is based on searches of the National Electronic Library for Medicines (NeLM), Medline, Google Scholar and publishers' websites

The use of inhaled therapy is of great importance in the treatment of asthma and chronic obstructive pulmonary disease (COPD) and other respiratory conditions. However, a substantial percentage of users of inhaler devices worldwide have been found to have inadequate technique or to make critical errors, which means that they do not obtain full benefit from their medication. Despite attention by researchers and the introduction of new types of device, real life use of inhalers seems to have made little progress over the past thirty years.

Training of patients by health professionals has been shown to be an effective means of improving this situation, but it needs to be repeated at intervals, and it is essential that those providing the training are themselves able to demonstrate correct technique. Pharmacists have played a leading role in educating patients in the use of their inhalers.

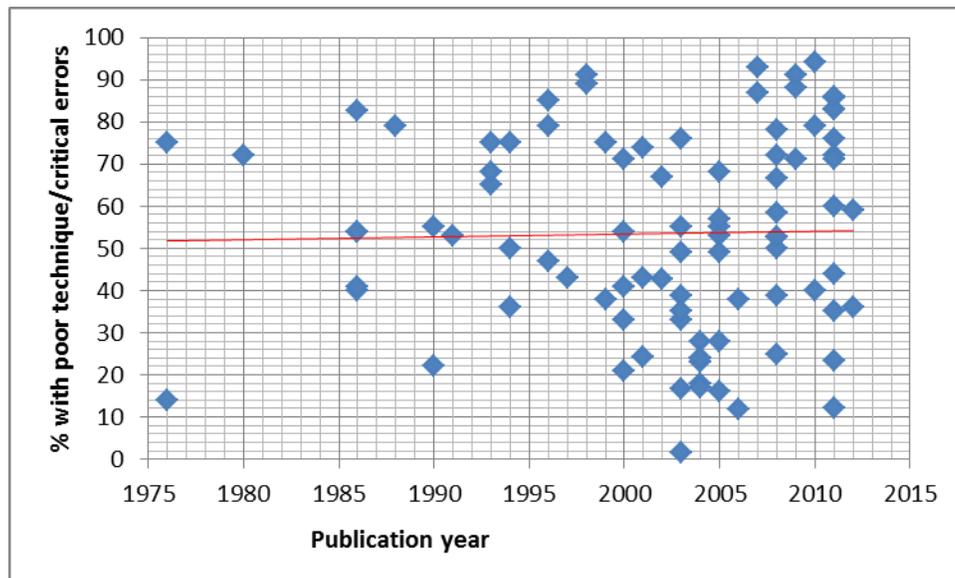
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Synopsis

The use of inhaled therapy is of great importance in the treatment of asthma and chronic obstructive pulmonary disease (COPD) and is also used in a number of other less common conditions, such as cystic fibrosis³⁸ and delivering antivirals⁵⁰.

The diagram below shows the percentages of established inhaler users who have been found to have inadequate inhaler technique, or to make critical errors in use of their inhaler, at baseline as reported in 90 studies published since 1976 and included in this bibliography.



There is a very wide spread of values, due to the extremely heterogeneous nature of the studies (study population, type of inhaler, method of evaluating technique, etc.). No statistical validity is claimed for the trend line, but it is perhaps reasonable to conclude that improper use of inhalers by patients is an important factor affecting inhaled therapy, and that despite considerable attention by researchers and the development of several new and improved types of inhaler, there has been no sustained improvement over the past 35 years in patients' ability to use their inhalers.

Concern about the real-world use of inhalers was recently expressed by an international panel of healthcare providers, academics and a patient representative, convened under the auspices of the International Primary Care Respiratory Group (IPCRG)¹³⁴.

Specific population groups investigated have included small children (or their parents or carers)^{41, 73, 182}, older children and adolescents^{4, 12, 26, 27, 85, 94, 95, 136, 164, 170, 180}, older people^{3, 7, 8, 14, 19, 24, 45, 48, 50, 74, 79, 169}, and pregnant women¹²³. One study found a significantly lower rate of correct use of metered-dose inhalers in women than in men⁶⁴, although another study found no difference³³.

Failure to use inhalers correctly, like other lapses of adherence to prescribed treatment, would be expected to result in higher morbidity and poorer control of chronic disease^{103, 114, 119}, increased cost⁵⁷ and possibly greater risk to the patient from exposure to less well-tolerated alternative treatments. It can potentially have very serious consequences in the event of acute exacerbations, if the patient is not able to administer inhaled emergency treatment quickly and effectively¹⁷⁸.

It has been noted that clinical trials of inhaled therapy tend to exclude patients with poor technique, so performance in the real world may not match that expected from clinical trials⁷².

Training in inhaler technique has been shown to improve asthma symptoms^{122, 190}, health-related quality of life^{36, 71} and respiratory functional status^{28, 36, 165}, minimise short-acting beta-agonist use⁸⁷ and reduce emergency hospital admissions^{87, 112, 140, 168}.

A study in 2005²⁵ attributes incorrect use of inhalers not simply to patients' lack of competence, but also to 'contrivance', in that patients deliberately contrive to use inhalers in a way different from that directed. This presumably relates to their attitude to medications, their medication-taking behaviour and their relationships with health professionals, and perhaps to aspects of the device or medication which have not been considered or investigated. It is an area that warrants further research.

However, there is a great deal of evidence showing that patients' competence in the self-administration of inhaled medications can be markedly improved by educational interventions.

Two current projects in England to improve patients' inhaler technique involve the training of health care professionals in the Isle of Wight^{87, 193} and the production of a set of cards by University Hospitals of Leicester NHS Trust to help remind health care professionals on how to use each different type of inhaler device¹⁹⁴.

Some key points suggested by the literature summarised below are as follows:

- Package inserts and patient information leaflets may not be written in suitable language and appropriately illustrated^{151, 153, 181}, even where no actual language barrier exists⁶⁵, and print may be too small for some older patients⁴⁵. Specific training materials may require to be produced^{80, 188, 189}
- Patients may not receive adequate (or indeed any) instruction when they first receive an inhaler^{38, 53, 103, 147, 179}, particularly if the medicine is supplied over the counter^{156, 157}
- Health professionals should not assume that their patients are being trained in inhaler use by others^{19, 48}

- Inhaler technique has been found to deteriorate over time (possibly after as little as 2-3 months), so instruction needs to be repeated at intervals^{43, 52, 98, 145}
- Existing inhaler users should be screened periodically to ensure they are using a correct technique^{55, 91}
- Psychosocial factors such as motivation seem to be important in maintaining good inhaler technique¹³³
- Patients' perception of their inhaler skills has been found to correlate poorly with their performance assessed objectively⁷⁹
- Verbal instruction is required in addition to written material^{126, 130, 146}
- Instruction should include "show and tell" techniques^{52, 54}
- Instruction should have regard to the patient's level of (health) literacy¹⁰⁰
- After instructing patients in the use of inhalers, the patients should be required to demonstrate the correct use of their device^{26, 94, 164}
- Reliable evaluation of technique may be difficult to achieve and requires training for consistency between evaluators^{66, 149, 150}
- Multimedia, audiovisual or telemedicine techniques may prove useful in some cases for educating patients or evaluating their technique^{34, 86, 111, 125, 154, 160, 167}
- Trainer devices or software have been used successfully in some cases^{5, 47, 70, 93, 102, 106, 124, 163, 169}
- Non-availability of placebo inhalers can be a barrier to effective education of patients⁷⁵
- Pharmacists can play a valuable role in educating patients and offering advice in the correct use of inhalers, in hospitals^{22, 49, 81, 132, 166}, in clinics^{56, 168}, in primary care¹⁰⁵ and in the community^{1, 9, 11, 15, 18, 23, 32, 40, 58, 63, 68, 75, 78, 90, 91, 92, 97, 110, 172, 184}. Specific training for this role is considered desirable¹³¹. Pharmacy technicians have also been involved in this role in hospitals¹⁹¹
- One study found education by doctors to be more effective than education by nurses⁷¹
- Health professionals need to be able to use the correct technique themselves in order to educate patients, but this has been shown to be not always the case^{20, 57, 96, 159, 175}. Studies have found poor technique and benefits from

training in doctors^{69, 83, 99, 113, 138, 139, 144, 162, 173}, medical students¹⁸⁶, nurses^{69, 83, 128, 129, 138, 155} and pharmacists^{2, 16, 17, 29, 84, 97, 118, 174}. Members of healthcare teams responsible for respiratory patients should ensure that they keep up to date with new and modified inhalation devices⁴⁴

- Appreciable differences between inhaler devices have been shown as regards patients' ability to use them correctly^{6, 46, 50, 76, 77, 89, 107, 121, 135, 142, 143, 148, 152, 158, 176, 178, 183, 187}, but the results do not seem to be consistent¹⁶² (probably apart from the benefits of using a spacer with metered-dose inhalers^{24, 116}) and patient preference may not correlate with good technique^{161, 177}
- Changing inhaler device is likely to have an adverse impact on correct use⁶⁷
- Educating patients in inhaler use may improve adherence as well as technique^{39, 171}
- There may be some benefit in selecting a type of inhaler which the individual patient is best able to use correctly – even if this costs more, it may prove more cost-effective^{43, 44, 108, 120}

References

1. Pharmaceutical Care Awards - Improving inhaler technique in Workop

Anon

Pharmaceutical Journal 2 Jul 1994;**253**:26

This item briefly describes the work of a community pharmacist who offered asthma patients the opportunity to check their inhaler technique using a Vitalograph monitor. Patients were counselled if it was considered that their technique could be improved.

2. Do Saudi community pharmacists know how to use MDIs?

A Abdulwahab, Y Al-Harbi, MIM Ibrahim

Journal of Pharmacy Practice and Research Mar 2012;**42**(1):77

A student from the College of Pharmacy, Qassim University, Saudi Arabia pretended to be a patient and visited five community pharmacies and asked about the proper inhalation technique for his newly prescribed Ventolin MDI for asthma. The student completed a checklist of 6 steps (inhalation technique described in the leaflet in the MDI box) after each visit.

The pharmacists demonstrated a haphazard technique and none discussed the 6 steps listed in the MDI leaflet. None of the pharmacists advised 'shake before use' or 'press on the top of the canister while breathing in' which are the most important steps to ensure drug deposition and therapeutic benefits.

The writers of this letter hope the findings do not reflect 'real' practice in Saudi community pharmacies. Community pharmacists are regarded as a safety net because they accept the responsibility of ensuring that patients understand their medications and get appropriate counselling. However, according to this survey, this is not the case, as the simulated patient was confused and left five pharmacies without learning how to use his Ventolin MDI.

The writers consider that a large study exploring the impact on patient outcomes is warranted, and recommend that training of pharmacists on asthma counselling, especially MDI technique, be compulsory.

http://jppr.shpa.org.au/lib/pdf/2012_03/Mohamed_Izham_LE.pdf

3. Teaching elderly patients how to use inhalers. A study to evaluate an education programme on inhaler technique, for elderly patients

C Abley

Journal of Advanced Nursing Apr 1997;**25**(4):699-708

Elderly patients often receive little or no teaching on the use of their inhalers. This study evaluated a patient teaching programme, designed specifically for elderly people. The sample (n = 27) was taken from patients who were prescribed inhalers and had been admitted to the elderly care wards of an acute provider unit. Individual inhaler technique was assessed, using a simple checklist, both before and after teaching and total scores calculated. Each subject received one to one teaching sessions by a registered nurse on four consecutive occasions that inhaled medication was due, together with an information sheet on inhaler technique. Total scores showed significant improvement; however, improvement on any one action was not found to be significant. Thus patient teaching leads to a significant improvement in inhaler technique; however, further research is necessary to determine whether this improvement is sustained over time. Recommendations for practice are made.

<http://onlinelibrary.wiley.com/doi/10.1046/j.1365-2648.1997.1997025699.x/abstract>

4. Importance of training for correct Turbuhaler use in preschool children

L Agertoft, S Pedersen

Acta Paediatrica Aug 1998;**87**(8):842-847

Aim: To study the impact of both audiovisual information and nurse-training on the use of budesonide Turbuhaler in preschool children who had never used a dry powder inhaler.

Design: A single-blind, randomised, parallel-group trial studied 72 children aged 3-5 years. All children and their parents were shown an instructional video and given written instruction. After this, peak inspiratory flow (PIF1) through Turbuhaler was measured. Children in group A (n = 36) then received individual training by a nurse while those in Group B (n = 36) did not and PIF2 was measured. Afterwards, Group B received similar individual training while Group A received no additional training, and PIF3 was measured. Group A was given a placebo Turbuhaler and encouraged to practice at home. Two weeks later, both groups returned to the clinic where PIF4 was measured.

Results: The number of children who were able to correctly perform PIF1, PIF2 and PIF4 in Group A was 27, 34 and 36, respectively. The corresponding numbers for Group B were 30, 29 and 29. No effect of training was seen in 3-year-old children. Individual training by a nurse was associated with a statistically significant increase in PIF2 (10 L/min; p = 0.014). Moreover, 2 weeks of home training was associated with an additional increase in PIF of 8 L/min compared with Group B (p less than 0.015). After individual instruction and home training, mean PIF in children aged 4 and 5 was 56 (42-72) and 55 (41-66) L/min, respectively.

Conclusions: After individual instruction and training at home, the vast majority of children aged 4 and 5 years can use Turbuhaler correctly. Audiovisual information and individual instruction is not sufficient in the majority of these children. Few 3-year-old children can learn the correct use of Turbuhaler.

<http://onlinelibrary.wiley.com/doi/10.1111/j.1651-2227.1998.tb01548.x/abstract>

5. The potential of a 2Tone Trainer to help patients use their metered-dose inhalers

RAM Al-Showair, SB Pearson, H Chrystyn

Chest Jun 2007;**131**(6):1776-

Investigation of whether a training aid (2Tone Trainer (2T); Canday Medical Ltd; Newmarket, UK) helps to maintain the correct inhaler technique after patients leave the clinic. Asthmatic patients who had been prescribed an MDI had their inhalation technique assessed. Their peak inhalation flow (PIF) when using their MDI, FEV1, and the Juniper asthma quality of life questionnaire (AQLQ) score were measured. Those patients using the recommended MDI technique were the good-technique (GT) group. The remainder were randomised to receive verbal training (VT) or VT plus the 2T to improve their MDI technique. All patients returned 6 weeks later. There were 36, 35 and 36 asthmatic patients, respectively, who completed the GT, VT and 2T procedures. FEV1 did not change within all groups between visit 1 and 2. PIF and AQLQ score did not change in the GT group. In the VT and 2T groups, the AQLQ score increased by mean differences of 0.33 (95% CI, 0.14 to 0.53; p less than 0.001) and 0.74 (95% CI, 0.62 to 0.86; p less than 0.001). At visit 1, all patients in the VT and 2T groups inhaled more than 90 L/min decreasing to 12 patients and 1 patient, respectively, at visit 2 (p less than 0.001 both groups). The overall changes in the 2T group for PIF and AQLQ score, between visits 1 and 2, were significantly (p

less than 0.001) greater than the corresponding changes in the VT group. Concludes that the 2T helps patients to maintain the recommended MDI technique post-training with improvements in AQLQ score.

<http://chestjournal.chestpubs.org/content/131/6/1776.abstract>

6. Can all patients with COPD use the correct inhalation flow with all inhalers and does training help?

RAM Al-Showair, WY Tarsin, KH Assi, SB Pearson, H Chrystyn
Respiratory Medicine Nov 2007;**101**(11):2395-2401

The inhalation rate is important when patients use an inhaler. Dry powder inhalers (DPIs) require an inhalation rate above 30 L/min whereas metered dose inhalers (MDIs) should be used at less than 90 L/min. Within the setting of a routine clinic, the authors measured peak inhalation flows (PIF) of COPD patients when they used a Diskus (SDSK), Turbuhaler (STBH), Handihaler (SHAND) and MDI. Subjects were then randomised into trained (VT) and non-trained (NT) groups. 163 patients with a mean (SD) age and % predicted FEV1 of 72.5 (9.9) years and 47.8 (22.2)% completed the study. Of the patients, 4.9%, 14.2% and 57.0% inhaled less than 30 L/min through SDSK, STHB and SHAND, respectively and 59.5% inhaled more than 90 L/min with the MDI. Generally, the more severe the COPD, the slower was their PIF with all inhalers. The MDI PIF values in the VT group (n = 84) post-training were significantly (p less than 0.001) slower but there was no change for the DPIs. Of the 55 VT patients inhaling more than 90 L/min through the MDI only 7 (p less than 0.001) inhaled too fast post-training. Pre-training 3, 15 and 46 VT subjects inhaled less than 30 L/min through the SDSK, STBH and SHAND and after training none, 5 and 26 did not inhale faster than this minimum required rate. Concludes that some COPD patients have problems achieving required PIFs through DPIs but training is useful to help some exceed the minimum required rate despite only small improvements. The patients found it easier to slow their PIF through the MDI.

[http://www.resmedjournal.com/article/S0954-6111\(07\)00261-2/abstract](http://www.resmedjournal.com/article/S0954-6111(07)00261-2/abstract)

7. What determines whether an elderly patient can use a metered dose inhaler correctly?

SC Allen, A Prior

British Journal of Diseases of the Chest 1986;**80**:45-49

The metered dose inhaler (MDI) technique of 30 elderly patients (mean age 79.9 years) was assessed. 60% were competent, though only 10% had an ideal technique; 40% were incompetent. Inadequate timing of actuation and inhalation was the most frequent error made. Competence was significantly related to mental status questionnaire (MSQ) scores of 7/10 or more. Patients who were first prescribed an MDI in hospital were significantly more likely to be competent than those prescribed an MDI by the general practitioner. Competence was not related to age, underlying diagnosis or duration of MDI therapy. Elderly patients requiring MDI therapy should be carefully selected and properly instructed by the prescribing doctor.

[http://dx.doi.org/10.1016/0007-0971\(86\)90008-2](http://dx.doi.org/10.1016/0007-0971(86)90008-2)

8. Ability to learn inhaler technique in relation to cognitive scores and tests of praxis in old age

SC Allen, S Ragab

Postgraduate Medical Journal Jan 2002;**78**(915):37-39

Clinical observations have shown that some older patients are unable to learn to use a metered dose inhaler (MDI) despite having a normal abbreviated mental test (AMT) score, possibly because of dyspraxia or unrecognised cognitive impairment. 30 inhaler-naive inpatients (age 76–94) with an AMT score of 8–10 (normal) were studied. Standard MDI training was given and the level of competence reached was scored (inhalation score). A separate observer performed the minimal mental test (MMT), Barthel index, geriatric depression score (GDS), ideational dyspraxia test (IDT) and ideomotor dyspraxia test (IMD). No correlative or threshold relationship was found between inhalation score and Barthel index, GDS or IDT. However, a significant correlation was found between inhalation score and IMD ($r = 0.45$, $p = 0.039$) and MMT ($r = 0.48$, $p = 0.032$) and threshold effects emerged in that no subject with a MMT score of less than 23/30 had an inhalation score of 5/10 or more (adequate technique requires 6/10 or more), and all 17/18 with an inhalation score of 6/10 or more had an IMD of 14/20 or more.

The 3 patients with a MMT above 22 and inhalation score below 6 had abnormal IMD scores. Inability to learn an adequate inhaler technique in subjects with a normal AMT score appears to be due to unrecognised cognitive impairment or dyspraxia.

The MMT is probably a more useful screening test than the AMT score in this context.

<http://pmj.bmj.com/content/78/915/37.abstract>

9. Using the community pharmacy to identify patients at risk of poor asthma control and factors which contribute to this poor control

CL Armour, K Lemay, B Saini, HK Reddel, SZ Bosnic-Anticevich, LD Smith, D Burton, YJ Song, MC Alles, K Stewart, L Emmerton, I Krass

Journal of Asthma Nov 2011;**48**(9):914-922

Background: Although asthma can be well controlled by appropriate medication delivered in an appropriate way at an appropriate time, there is evidence that management is often suboptimal. This results in poor asthma control, poor quality of life, and significant morbidity.

Methods: The objective of this study was to describe a population recruited in community pharmacy identified by trained community pharmacists as being at risk for poor asthma outcomes and to identify factors associated with poor asthma control. It used a cross-sectional design in 96 pharmacies in metropolitan and regional New South Wales, Victoria, Queensland and Australian Capital Territory in Australia. Community pharmacists with specialised asthma training enrolled 570 patients aged 18 years or older with doctor-diagnosed asthma who were considered at risk of poor asthma outcomes and then conducted a comprehensive asthma assessment. In this assessment, asthma control was classified using a symptom and activity tool based on self-reported frequency of symptoms during the previous month and categorized as poor, fair, or good. Asthma history was discussed, and lung function and inhaler technique were also assessed by the pharmacist. Medication use/adherence was recorded from both pharmacy records and the Brief Medication Questionnaire (BMQ).

Results: The symptom and activity tool identified that 437 (77%) recruited patients had poor asthma control. Of the 570 patients, 117 (21%) smoked, 108 (19%) had an action plan, 372 (69%) used combination of inhaled corticosteroid (ICS)/long-acting beta(2)-agonist (LABA) medications and only 17-28% (depending on device) used their inhaler device correctly. In terms of adherence, 90% had their ICS or ICS/LABA dispensed fewer than 6 times in the previous 6 months, which is inconsistent with regular use; this low adherence was confirmed from the BMQ scores. A logistic regression model showed that patients who smoked had incorrect

inhaler technique or low adherence (assessed by either dispensing history or BMQ) and were more likely to have poor control.

Conclusions: Community pharmacists were able to identify patients with asthma at risk of suboptimal control, and factors that contributed to this were elicited. This poorly controlled group that was identified may not be visible or accessible to other health-care professionals. There is an opportunity within pharmacies to target poorly controlled asthma and provide timely and tailored interventions.

<http://informahealthcare.com/doi/abs/10.3109/02770903.2011.615431>

10. Patients' opinions of CFC-free inhaler changeover in primary care

F Arris, L Thorburn, DJ McCaig

Pharmacy World and Science Oct 2001;**23**(5):173-174

Study of 28 patients at a hospital respiratory outpatient clinic receiving salbutamol metered-dose inhaler therapy. Only 8 had been changed to a CFC-free product. 6 of these had received counselling from their GP or pharmacist regarding the change. Differences were reported by patients who had been changed to a CFC-free inhaler with comments including difference in taste or difference in feel, less effective and more effective. 3 patients preferred the CFC-free inhaler. Although 13 out of the 20 patients who had not received a CFC-free inhaler stated they were happy with the potential changeover, 10 had concerns relating to effectiveness.

<http://www.springerlink.com/content/r067t72562344726/>

11. The role of the community pharmacist in asthma education

JG Ayres, N Butler

British Journal of Pharmaceutical Practice Jun 1987;**9**:202-205

A questionnaire was sent to 28 community pharmacists to determine their knowledge of inhaler therapy, their perception of the role of the pharmacist in asthma management and the fulfilment of that role. 22 (78%) of pharmacists responded. 19 felt they were demonstrating correct inhaler technique. 17 did so only when asked by the patient. 13 obtained their information from the package insert and 12 knew about the availability of placebo kits. Only one of the pharmacists knew that 10% of the inhaled dose reaches the lungs. The authors use this to conclude that the pharmacists' knowledge of inhaler theory was poor. 77% of responders were interested in attending a workshop on asthma.

12. Aerosol inhaler technique in children with asthma

AM Baciewicz, KS Kyllonen

American Journal of Hospital Pharmacy 1 Dec 1989;**46**(12):2510-2511

A small study group of 25 children aged between 7 years 6 months and 18 years were assessed visually using generally accepted steps for appropriate inhaler technique. The average number of inhalers used was two per child and 60% of children had used inhalers for 1-3 years and 20% for more than 5 years. No pulmonary function tests were performed. No child was observed to have completed all inhaler techniques correctly and there was an average of 5.1 errors per child. Each child was re-instructed regarding correct inhaler technique and it was concluded that all children need several educational follow-up sessions to reinforce correct inhaler technique.

<http://www.ajhp.org/content/46/12.toc>

13. A survey of outpatients' salbutamol inhaler technique

C Banias, SF Hurley

Australian Journal of Hospital Pharmacy Sep 1986;**16**:175-177

40 hospital outpatients were questioned about use of their salbutamol inhaler and their technique was evaluated. 37 of the patients had been shown initially how to use their inhaler - none by a pharmacist. Only 13 patients had had their technique checked after initial use - 2 of these by a pharmacist. When inhaler technique was evaluated only 7 (17.5%) patients had perfect technique and 50% did not hold their breath after using their inhaler. All patients were able to achieve correct technique after being instructed. It is concluded that pharmacists' involvement in education about inhaler use at present is minimal and that this is a field in which they could contribute towards patient compliance.

14. Inhaler device selection: special considerations in elderly patients with chronic obstructive pulmonary disease

R Barrons, A Pegram, A Borries

American Journal of Health-System Pharmacy 1 Jul 2011;**68**(13):1221-1232

The American Journal of Health-Systems Pharmacy has featured a review of special considerations required in the selection of medication inhaler devices for elderly patients with chronic obstructive pulmonary disease (COPD) in the ambulatory care setting.

The authors conclude that "In elderly patients with sufficient cognitive function, manual dexterity, and hand strength, the most important factors in inhaler device selection are cost reimbursement issues, device availability, device convenience, and patient preference. Pharmacist knowledge of appropriate inhaler technique, competent patient education and demonstration, and follow-up assessment are instrumental in optimising device competency and medication adherence."

<http://www.ajhp.org/content/68/13/1221>

15. Evaluation of a novel educational strategy, including inhaler-based reminder labels, to improve asthma inhaler technique

IA Bsheti, CL Armour, SZ Bosnic-Anticevich, HK Reddel

Patient Education and Counseling Jul 2008;**72**(1):26-33

Evaluation of the feasibility, acceptability and effectiveness of a brief intervention about inhaler technique, delivered by community pharmacists in Australia to asthma patients. 31 pharmacists received brief workshop education (Active: n = 16, Control: n = 15). Active group pharmacists were trained to assess and teach dry powder inhaler technique, using patient-centred educational tools including novel Inhaler Technique Labels. Interventions were delivered to patients at 4 visits over 6 months. At baseline, patients (Active: 53, Control: 44) demonstrated poor inhaler technique (mean +/- SD score out of 9, 5.7 +/- 1.6). At 6 months, improvement in inhaler technique score was significantly greater in active vs control patients (2.8 +/- 1.6 vs 0.9 +/- 1.4, p less than 0.001), and asthma severity was significantly improved (p = 0.015). Qualitative responses from patients and pharmacists indicated a high level of satisfaction with the intervention and educational tools, both for their effectiveness and for their impact on the patient-pharmacist relationship. Concludes that a simple feasible intervention in community pharmacies, incorporating daily reminders via Inhaler Technique Labels on inhalers, can lead to improvement in inhaler technique and asthma outcomes.

[http://www.pec-journal.com/article/S0738-3991\(08\)00014-1/abstract](http://www.pec-journal.com/article/S0738-3991(08)00014-1/abstract)

16. Long-term maintenance of pharmacists' inhaler technique demonstration skills

IA Basheti, CL Armour, HK Reddel, SZ Bosnic-Anticevich

American Journal of Pharmaceutical Education 2009;**73**(2):32

To assess the effectiveness of a single educational intervention, followed by patient education training, in pharmacists retaining their inhaler technique skills, a convenience sample of 31 Australian pharmacists attended an educational workshop and their inhaler techniques were assessed. Those randomly assigned to the active group were trained to assess and teach correct Turbuhaler and Diskus inhaler techniques to patients and provided with patient education tools to use in their pharmacies during a 6-month study. Control pharmacists delivered standard care. All pharmacists were reassessed 2 years after initial training. 31 pharmacists participated in the study. At the initial assessment, few pharmacists demonstrated correct technique (Turbuhaler: 13%, Diskus: 6%). All pharmacists in the active group demonstrated correct technique following training. 2 years later, pharmacists in the active group demonstrated significantly better inhaler technique than pharmacists in the control group (p less than 0.05) for Turbuhaler and Diskus (83% vs 11%; 75% vs 11%, respectively). Concludes that providing community pharmacists with effective patient education tools and encouraging their involvement in educating patients may contribute to pharmacists maintaining their competence in correct inhaler technique long-term. (24 refs.)

<http://www.ajpe.org/doi/pdf/10.5688/aj730232>

17. User error with Diskus and Turbuhaler by asthma patients and pharmacists in Jordan and Australia

IA Basheti, E Qunaibi, SZ Bosnic-Anticevich, CL Armour, S Khater, M Omar, HK Reddel

Respiratory Care Dec 2011;**56**(12):1916-1923

Background: Use of inhalers requires accurate completion of multiple steps to ensure effective medication delivery.

Objective: To evaluate the most problematic steps in the use of Diskus and Turbuhaler for pharmacists and patients in Jordan and Australia.

Methods: With standardised inhaler-technique checklists, we asked community pharmacists to demonstrate the use of Diskus and Turbuhaler. We asked patients with asthma to demonstrate the inhaler (Diskus or Turbuhaler) they were currently using.

Results: 42 community pharmacists in Jordan, and 31 in Australia, participated. In Jordan, 51 asthma patients demonstrated use of Diskus and 40 demonstrated use of Turbuhaler. In Australia, 53 asthma patients demonstrated use of Diskus and 42 demonstrated use of Turbuhaler.

Results: The pharmacists in Australia had received inhaler-technique education more recently than those in Jordan ($P = 0.03$). With Diskus, few pharmacists in either country demonstrated correct technique for step 3 (exhale to residual volume) or step 4 (exhale away from the device), although there were somewhat fewer errors in Australia than Jordan (16% vs 0% in step 3, $P = 0.007$, and 20% vs 0% in step 4, $P = 0.003$ by the chi-squared test). With Turbuhaler there were significant differences between the pharmacists from Australia and Jordan, mainly in step 2 (hold the device upright while loading, 45% vs 2% correct, P less than 0.001). Few of the patients had received inhaler-technique education in the previous year. The patients made errors similar to those of the pharmacists in individual steps with Diskus and Turbuhaler. The essential steps with Diskus were performed correctly more often by the Jordanian patients, and with Turbuhaler by the Australian patients.

Conclusions: Despite differences in the health systems of Jordan and Australia health systems, pharmacists from both Australia and Jordan had difficulty with the same Diskus and Turbuhaler steps. In both countries, the errors made by the asthma patients were similar to those made by the pharmacists.

See also Reference 60.

<http://www.rcjournal.com/contents/12.11/contents.cfm>

18. Improved asthma outcomes with a simple inhaler technique intervention by community pharmacists

IA Baseti, HK Reddel, CL Armour, SZ Bosnic-Anticevich

Journal of Allergy and Clinical Immunology Jun 2007;**119**(6):1537-1538

Letter reporting a study in a convenience sample of 31 community pharmacists in the Sydney metropolitan area, Australia (active, 16; control, 15), of whom 27 completed the study. Community pharmacists were trained to deliver education on Turbuhaler or Diskus (GlaxoSmithKline, Victoria, Australia) technique and peak flow meter (PFM) technique (active group) or PFM technique alone (control group). After training, all pharmacists demonstrated correct Turbuhaler and Diskus technique. Pharmacists then approached every second asthmatic patient who presented a Turbuhaler or Diskus prescription at their pharmacy. After a 2-week run-in period during which PFM readings were recorded, patients in the active group visited the pharmacy for 5 visits (time = 0, 1, 2, 3 and 6 months) at which the intervention was delivered. The intervention included a specialised 'show-and-tell' inhaler technique counselling service, with augmented verbal counselling and physical demonstration with a placebo inhaler, addressing all steps in the inhaler technique checklist. Assessment and counselling were repeated up to 3 times if necessary, until the patient demonstrated the correct technique. At each subsequent visit, inhaler technique assessment and education were repeated. Patients in the control group visited the pharmacy for assessment at the same intervals and received standard care. Both groups also performed 2 weeks of peak flow monitoring before visits at 3 and 6 months.

116 patients were enrolled, and 97 (84%) completed the study. At entry, correct inhaler technique was displayed by 7% of Turbuhaler users and 13% of Diskus users. Inhaler technique education took an average of 2.5 minutes per patient per visit.

The intervention had a significant effect on inhaler technique and clinical and humanistic outcomes for both the Turbuhaler and Diskus groups. At 3 months, the correct technique was demonstrated by 85% of active Turbuhaler users and 96% of active Diskus users (control group not assessed). There was a significant difference in the proportion of Turbuhaler and Diskus users who were able to demonstrate correct technique after 6 months compared with the control group.

These observations confirm that rechecking and re-educating patients about inhaler technique needs to be a regular and ongoing process. Community pharmacists are well placed to do this because they can engage the patient every time an inhaler is dispensed.

[http://www.jacionline.org/article/S0091-6749\(07\)00439-3/fulltext](http://www.jacionline.org/article/S0091-6749(07)00439-3/fulltext)

19. Evaluation of the use of inhaled medications by hospital inpatients with chronic obstructive pulmonary disease

J Batterink, K Dahri, A Aulakh, C Rempel

Canadian Journal of Hospital Pharmacy 2012;**65**(2):

Background: The prevalence of chronic obstructive pulmonary disease (COPD) is increasing. Patients with COPD are treated with a variety of inhaled medications.

Previous studies evaluating inhaler technique have had varied results but have generally found high rates of misuse of these devices. There is a paucity of studies of inhaler technique focusing on North American patients with COPD who have been admitted to hospital.

Objective: To evaluate the inhaler technique of patients with COPD who have been admitted to hospital and to identify baseline patient characteristics and/or inhaler devices associated with poor inhaler technique.

Methods: Patients with a diagnosis of COPD who were admitted to the hospitalist or internal medicine service at a tertiary care hospital in British Columbia, Canada, between Oct 2010 and Apr 2011 were identified. After giving informed consent, recruited patients demonstrated their inhaler technique, which was evaluated with standardised checklists. Errors in technique were categorised as either noncritical or critical. Critical errors were defined as those resulting in little or no medication reaching the lungs.

Results: 37 patients (mean age 78 years) participated in the study. 22 (59%) of the patients made critical errors while demonstrating their inhaler technique. Patients using metered-dose inhalers were more likely to make a critical error than patients using other inhalers (13/14 (93%) vs 9/23 (39%); relative risk 2.38, $p = 0.002$). On average, 26% of the steps for using an inhaler were performed incorrectly. 23 (62%) of the patients reported having received previous counselling on inhaler technique, but only 13 (57%) of these 23 patients had received such counselling in the previous 6 months.

Conclusions: More than half of the patients in this study misused their inhaler devices, and many made critical errors that would result in inadequate amounts of drug reaching the lung. Many of the patients were not receiving regular counselling on appropriate inhaler technique. Health care professionals should be aware of poor inhaler technique, should routinely evaluate their patients' inhaler technique, and should provide counselling.

<http://www.cjhp-online.ca/index.php/cjhp/article/view/1118>

20. Do healthcare professionals have sufficient knowledge of inhaler techniques in order to educate their patients effectively in their use?

M Baverstock, N Woodhall, V Maarman

Thorax Dec 2010; **65**(Suppl.4):A117-A118

Paper presented at the British Thoracic Society Winter Meeting, Dec 2010. Respiratory education and training issues: P94.

Introduction and objectives: Inhalers are widely used in the treatment of asthma and chronic obstructive pulmonary disease (COPD). For patients to gain maximum benefit they need to be educated by competent healthcare professionals (HCPs) whose own competence meets accepted standards. This study looked at HCPs ability to use the commonly prescribed metered dose inhaler (pMDI).

Methods: 150 healthcare professionals (74 Primary Care Trust; 76 Acute Trust) were asked to demonstrate how they would self-administer a pMDI placebo inhaler. The group included hospital doctors, hospital nurses, general practitioners, practice nurses, hospital and community pharmacy staff. Each professional was marked against a standard set by the manufacturer and Education for Health UK. They were also asked to demonstrate the correct inspiratory flow rate using the In-check dial device.

Results: Of the 150 HCPs assessed only 11 (7%) could demonstrate all the recognised steps in administration including assessment of inspiratory flow using the In-check device. 113 (75%) of the HCPs said they were involved in the teaching of

inhaler technique. Of these 113, 11 (9%) could demonstrate all the recognised steps (n = 10, PCT; n = 1, acute trust). Of the 150, 72 (48%) were prescribers or were involved in prescribing. 94 (63%) had received some training on inhaler technique in the past of whom 64 (67%) said the training took place more than a year before. Conclusions: If we are going to adequately educate our patients with regard to their inhaler usage we as HCPs need to be competent in how each device works. Incorrect teaching and assessment will increase use of healthcare resources, waste medication, and mean worsening symptoms and poor control of airways disease for our patients.

http://thorax.bmj.com/content/65/Suppl_4/A117.3.abstract

21. Metered-dose inhalers: the specified number of sprays

A Bergner, WA Greisner, RK Bergner

Journal of the American Medical Association 24-31 Mar 1993;**269**:1506 (letter)

Manufacturers of metered-dose inhalers (MDI) specify the total number of inhalations available from the canister. Although the canister is not completely empty after the specified number of inhalations have been administered, the meter chamber may not fill uniformly and subsequent doses may diminish. Pt unaware of this problem often continue to use their MDI until all the contents are exhausted, a practice which could result in inadequate dosing and asthma exacerbation. Patients should be educated as to the need to count inhalations and, once the specified number has been reached, to discard the MDI.

<http://jama.ama-assn.org/content/269/12/1506.extract>

22. Inhaled medications as an example of patient education

(Patientenschulungen am Beispiel inhalativer Arzneiformen)

C Biegert

Krankenhauspharmazie May 2009;**30**(5):245-247

The pharmacological treatment of bronchial asthma and COPD mainly involves inhaled drugs. The handling of these medications can be challenging for patients due to the complexity and variety of the inhalation devices. The aim of patient counselling is to encourage the correct administration of the inhaled drugs and to increase the compliance to ensure a better therapy for the patients. Pharmacists are experts in pharmaceutical technology and pharmacology and are therefore highly qualified to train patients in the correct handling of inhalation devices. The therapeutic success depends on the correct administration of these medicines. In this way, pharmacists are able to support doctors by carrying out such time-consuming counselling and make a great contribution to achieving effective therapy.

<http://www.krankenhauspharmazie.de/archiv/verzeichnis/2009/05.html>

23. Metered-dose inhaler technique: the effect of two educational interventions delivered in community pharmacy over time

SZ Bosnic-Anticevich, H Sinha, S So, HK Reddel

Journal of Asthma Apr 2010;**47**(3):251-256

Instruction is critical in order to ensure correct technique with pressurised metered-dose inhalers (pMDIs) by patients. The aim of this study in Australia was to compare the effects over time of two educational interventions delivered in community pharmacy to pMDI users. In this randomised controlled parallel-group study, pMDI technique was assessed before and after written and verbal instruction, alone or with physical demonstration, at baseline and 4, 8 and 16 weeks. The study recruited 52 subjects with asthma or chronic obstructive pulmonary disease (COPD). Initially only

1/52 (6%) subject had correct pMDI technique (= checklist score 8/8), with mean baseline score 5 (SD 1) for both groups. Written and verbal information improved pMDI technique at 16 weeks (7 +/- 1, p less than 0.05). Addition of physical demonstration resulted in significant improvement at weeks 4, 8 and 16 (7 +/- 1, 7 +/- 1, 7 +/- 1 respectively; p less than 0.05 for each). Subjects receiving written and verbal information alone were less likely to return for follow-up than those receiving physical demonstration (8 weeks: 6/25 versus 19/27; p less than 0.001). By the 8-week visit, 80% of subjects in the physical demonstration group had correct technique prior to education, compared with 10% of subjects receiving written and verbal information alone (p less than 0.05). There was some decline in inhaler technique by 16 weeks. The results demonstrate that adding a physical demonstration is more effective in improving pMDI technique than written and verbal instructions alone.

<http://informahealthcare.com/doi/abs/10.3109/02770900903580843>

24. The use of inhaled and related respiratory medications in Christchurch rest homes

C Botting, M Sutherland, E Wells, I Town, R Sainsbury, L Toop

New Zealand Medical Journal 12 Dec 2003; **116**(1187):electronic pages

50% of Christchurch, New Zealand, rest homes were randomly selected. All residents on asthma medications, the rest-home managers, care-giving staff, and the residents' GPs were interviewed using specific questionnaires. All of the rest homes, residents using asthma medications and senior staff members participated. 75% of caregivers and 73% of general practitioners took part. Asthma medications were used by 13% of 1416 rest-home residents. 84% of these used a preventer medication, mostly inhaled steroids. Some daily doses exceeded current treatment guidelines. One-third of residents using inhalers had an inadequate technique. Some staff and residents chose the wrong inhaler to manage 'shortness of breath'. Regular bronchodilator dosing, rather than 'as required', was common. Those using a spacer device usually had a good technique. Residents appreciated non-pharmacological strategies for breathlessness. Staff identified a need for clear written management plans. Concludes that there were significant deficiencies in the staff and residents' knowledge of obstructive airways management and medications. Regular review of inhaler technique, greater use of spacers, and regular staff education may improve residents' respiratory management. Inhaled corticosteroids may be used in too high a dose. Inconsistent management of acutely deteriorating asthma/chronic obstructive pulmonary disease may be addressed by greater use of written management plans in residents' notes.

<http://journal.nzma.org.nz/journal/116-1187/709/content.pdf>

25. True device compliance: the need to consider both competence and contrivance

VK Brennan, LM Osman, H Graham, A Critchlow, ML Everard

Respiratory Medicine Jan 2005; **99**(1):97-102

Inability to use inhalers effectively is known to adversely affect the delivery of drug. It is assumed that increasing competence to use inhalers will lead to improved drug delivery. However many subjects appear competent (are able to use a device effectively) but contrive to use the device in a sub-optimal way in routine use. This study aimed to explore levels of True device compliance, that is the extent to which devices are used effectively in routine use, and to explore the influences of age and device on this parameter. The ability of 53 asthmatic patients aged 1 to 88 years to

use their corticosteroid inhaler was assessed by a single investigator. In addition information regarding patient behaviour in routine practice was explored in a structured interview. True device compliance was defined to occur when a subject was rated competent and did not report contrivance. Competence was related to device type. All subjects using a holding chamber (pMDI+HC) (N = 21) or breath-activated inhaler (N = 5) could demonstrate an adequate technique compared with only 9 (47%) of those prescribed a pMDI. However, only 4 (19%) prescribed a pMDI+HC were true device compliant, with the majority regularly using the pMDI alone, while (42%) of those prescribed a pMDI were True device compliant. Since 82% of patients over 65 were prescribed pMDI alone, and 92% of patients up to 5 years were prescribed pMDI+HC, True device compliance was low among both groups. Only 33% of patients over 65 prescribed pMDIs were able to use them competently. Lack of competence, particularly in the elderly, and contrivance, particularly common amongst those using holding chambers, are two important but independent impediments to effective inhaled therapy.

<http://dx.doi.org/10.1016/j.rmed.2004.05.015>

26. An evaluation of children's metered-dose inhaler technique for asthma medications

PV Burkhart, MK Rayens, RK Bowman

Nursing Clinics of North America Mar 2005;**40**(1):167-182

Regardless of the medication delivery system, health care providers need to teach accurate medication administration techniques to their patients, educate them about the particular nuances of the prescribed delivery system (e.g. proper storage), and reinforce these issues at each health encounter. A single instruction session is not sufficient to maintain appropriate inhaler techniques for patients who require continued use. Providing written steps for the administration technique is helpful so that the patient can refer to them later when using the medication. The US National Heart, Lung, and Blood Institute's 'Practical Guide for the Diagnosis and Management of Asthma' recommends that practitioners follow these steps for effective inhaler technique training when first prescribing an inhaler: 1. Teach patients the steps and give written instruction handouts. 2. Demonstrate how to use the inhaler step-by-step. 3. Ask patients to demonstrate how to use the inhaler. Let the patient refer to the handout on the first training. Then use the handout as a checklist to assess the patient's future technique. 4. Provide feedback to patients about what they did right and what they need to improve. Have patients demonstrate their technique again, if necessary. The last two steps (i.e. demonstration and providing feedback on what patients did right and what they need to improve) should be performed at every subsequent visit. If the patient makes multiple errors, it is advisable to focus on improving one or two key steps at a time. With improvements in drug delivery come challenges, necessitating that practitioners stay current with new medication administration techniques. Teaching and reinforcing accurate technique at each health care encounter are critical to help ensure medication efficacy for patients with asthma. Since one-fifth of children in the study performed incorrect medication technique even after education, checklists of steps for the correct use of inhalation devices, such as those provided in this article, should be given to patients for home use and for use by clinicians to evaluate patient technique at each health encounter.

[http://www.nursing.theclinics.com/article/S0029-6465\(04\)00093-3/abstract](http://www.nursing.theclinics.com/article/S0029-6465(04)00093-3/abstract)

27. The effect of telepharmacy counselling on metered-dose inhaler technique among adolescents with asthma in rural Arkansas

A Bynum, D Hopkins, A Thomas, C Irwin, N Copeland

Pharmacotherapy Mar 2001;**21**(3):382

Telemedicine Journal and e-Health Fall 2001;**7**(3):207-217

Paper presented at the American College of Clinical Pharmacy spring practice and research forum, Salt Lake City, Utah, USA, 22-25 Apr 2001, abstract No.95. Also presented at the World Congress of High-Tech Medicine, Hanover, Germany, 16-20 Oct 2000.

The increased prevalence, morbidity, mortality, and health costs associated with asthma among children suggest the need for accessible asthma education. This study examined the effect of telepharmacy counselling, using interactive compressed video, on metered-dose inhaler (MDI) technique and patient satisfaction among adolescents with asthma in rural Arkansas (USA). The telepharmacy counselling provided accessible education regarding MDI technique for adolescents in this study. 20% of the adolescents who participated had never been shown the appropriate use of an MDI. The study used an experimental design with random assignment of participants to a telepharmacy counselling group (n = 15) or a control group (n = 21). Both groups participated in pre-test, post-test, and 2- to 4-week follow-up assessments for MDI technique and patients satisfaction (follow-up assessment only) via interactive compressed video. Results indicated that from pre-test to follow-up the telepharmacy counselling group showed more improvement in MDI technique than participants in the control group (p less than 0.001). There was no significant difference between the telepharmacy counselling group and control group in satisfaction with the instructional sessions (p = 0.132). Both groups had high levels of satisfaction with the telepharmacy sessions. The study findings demonstrated that patient education provided by pharmacists via interactive compressed video was superior to education provided via written instructions on an inhaler package insert. Interactive compressed video is an effective medium for teaching and improving MDI technique in this rural, adolescent, predominantly African-American population.

<http://online.liebertpub.com/doi/abs/10.1089/153056201316970902>

28. Effectiveness of the correct use of inhalation devices in patients with chronic obstructive pulmonary disease: randomised clinical trial

(Eficacia de la utilización correcta de los dispositivos de inhalación en pacientes con enfermedad pulmonar obstructiva crónica: ensayo clínico aleatorizado)

VR Cabedo Garcia, CR Garces Asemány, A Cortes Berti, JT Oteo Elso, FJ Ballester Salvador
Medicina Clinica 6 Nov 2010;**135**(13):586-591

Background and objective: The study aimed to assess whether an educational intervention on the use of inhalation devices improved the functional status of patients with COPD.

Patients and method: Randomised controlled trial with parallel design and simple blind trial performed in a clinic in Spain with 94 patients diagnosed with COPD and who used inhaler devices. Participants were randomised into 2 groups: the intervention group held training sessions on the use of inhalers at baseline and 1 month and the control group was supported with routine monitoring. The main outcome measure was the change in the composite index BODE (Body-Mass Index, Airflow Obstruction, Dyspnoea and Exercise Capacity).

Results: Patients in the intervention group (n = 48) experienced an improvement in the sensation of breathlessness decreasing by 0.85 points (95% CI, -1.14 to -0.56) on the MMRC dyspnoea scale, while the control group (n = 46) did not show any significant change, p less than 0.0001. On the walking test the intervention group walked 6.19 meters further (95% CI, -4.02 to 16.40) while the control group walked 20.55 meters less (95% CI, -37.80 to -3.28), a significant difference with p = 0.009.

The BODE index decreased (improved) -0.82 points in the intervention group (95% CI, -1.16 to -0.46) and increased (worsened) 0.20 points in the control group (95% CI, -0.16 to 0.56), p less than 0.0001.

Conclusions: Patients with COPD who receive specific training on inhaler use experience improvement in their functional state as compared with those with routine monitoring.

<http://www.sciencedirect.com/science/article/pii/S0025775310005324>

29. The ability of the community pharmacist to learn the proper actuation techniques of inhaler devices

WT Cain, G Cable, JJ Oppenheimer

Journal of Allergy and Clinical Immunology Dec 2001; **108**(6):918-920

Community pharmacists were recruited for this study and asked to demonstrate the proper steps in the actuation sequences of 3 inhaler devices. Baseline measurements were followed by an instructional session on the proper actuation technique, and then a post-test was conducted 4 to 6 weeks later. The mean changes between baseline and post-instruction percentage scores for the metered-dose inhaler device, the Turbuhaler, and the Diskus were (mean +/- SD) 17.1% +/- 15.4%, 22.6% +/- 18.7%, and 38.4% +/- 19.6%, respectively. This study demonstrates that a single instructional session can dramatically improve a community pharmacist's ability to demonstrate the correct method of actuation.

[http://www.jacionline.org/article/S0091-6749\(01\)20836-7/abstract](http://www.jacionline.org/article/S0091-6749(01)20836-7/abstract)

30. Metered dose inhalers

NA Caldwell, J McCabe, H Chrystyn, M Hindle, D Taylor

Pharmaceutical Journal 15 Jun 1991; **246**:722 (letters)

Two letters in response to a previous article by P Tunstell and D Taylor (*Pharm J* 18 May 1991, p.626, Reference 175) which examined the knowledge of both health professionals and patients on metered dose inhaler (MDI) technique. Caldwell and McCabe comment that the inhaler should be upright during dosing, and also that it is not necessary to have the inhaler positioned in the mouth; holding the MDI some 40mm from the mouth, inhaling slowly, and holding the breath for 10 sec, ensures the delivery of the maximum dose to the airways. There is a reply to these points by Taylor, one of the authors of the original article. Chrystyn and Hindle comment that although the patient's technique may be good, it is still possible for patients to achieve a sub-optimal clinical response. They present brief results of their research (see also Reference 78) which showed that the amount of salbutamol absorbed (and subsequently excreted in the urine) can vary even when patients have scored 9-10 in the system used in the original study. These authors also favour the open mouth technique mentioned above.

31. Inhaler technique and training in people with chronic obstructive pulmonary disease and asthma

TGD Capstick, IJ Clifton

Expert Review of Respiratory Medicine Feb 2012; **6**(1):91-103

Asthma and chronic obstructive pulmonary disease are both common conditions with an increasing prevalence worldwide. Inhaled therapy for these conditions has a number of advantages over systemic therapy, including reduced side effects and quicker onset of action. The effective use of inhaled therapy is critically dependent upon the nature of the drug-delivery system and the ability of the patient to use the system correctly. There are a wide number of inhaler devices on the market, each

with positive and negative aspects. A crucial part of patient care is to ensure that the choice of inhaler device for the individual is an effective therapy. There are a number of interventions that can help with the choice of inhaler device and also improve the ability of the patient to use inhaled therapy. Inhaler technique training needs to be a cornerstone of the care of patients with asthma or chronic obstructive pulmonary disease to ensure optimal therapy.

<http://www.expert-reviews.com/doi/abs/10.1586/ers.11.89>

32. Management of asthma in the pharmacy: a survey of 120 pharmacists in Bas-Rhin

(Prise en charge de l'asthme à l'officine: enquête auprès de 120 pharmaciens du Bas-Rhin)

A Casset, P Rebotier, F Lieutier-Colas, N Glasser, C Heitz, J Saigne, G Pauli, F De Blay

Revue des Maladies Respiratoires Nov 2004; **21**(5-Pt.1):925-933

Introduction: The pharmacist plays an essential role in the management of asthmatic patients on account of their frequent visits to the pharmacy to obtain their medication.

Methods: In order to evaluate the practice and knowledge of asthma among the pharmacists in the department of Bas-Rhin, France, 120 pharmacists were selected at random to reply to a standardised questionnaire.

Results: The 86 pharmacists who replied to the questionnaire had a good general understanding of asthma and its treatment. However, only 26.4% knew all the criteria of the severity of an attack of asthma. Among the 57 pharmacists who gave a demonstration of the use of inhaler devices, 16.3% showed all the steps in the use of a metered dose aerosol. These results are comparable to those of non-specialist doctors and nurses in whom poor techniques were found in 63-100% and 65-96% respectively. The mean scores of the pharmacists were 10.5/12 (+/- 1.2) steps for metered dose aerosols, 10.4/11 (+/- 1.0) for the Turbuhaler, 9.3/12 (+/- 1.7) for the Autohaler and 8.1/9 (+/- 0.9) for the Volumatic spacer. The asthmatic patient's main expectation from pharmacists concerned the use of the prescribed systems (87.2%), underlining the lack of information received by the patient at the time of prescribing.

Conclusions: An improvement in the knowledge of the signs of severity of asthma and the use of inhaler devices could usefully be one of the objectives in the training of dispensing pharmacists.

<http://www.sciencedirect.com/science/article/pii/S0761842504714746>

33. Gender differences in metered-dose inhaler-spacer device technique

CC Chafin, EA Tolley, CM George, K Demirkan, DA Kuhl, M Pugazhenth, TH Self

Pharmacotherapy Nov 2000; **20**(11):1324-1327

The purpose of the study was to determine whether gender affects the correct use of a metered-dose inhaler (MDI)-spacer device. The design was a prospective, observational study in university classrooms utilising 83 students in their third year of a Doctor of Pharmacy course. Students were given the device and received 20 minutes of education on its use. They then were asked to perform the technique. Assessment and retraining were done, as necessary, by clinicians who were experienced with the device. Students returned 1 week later to perform the technique again. The performance of men vs women was analysed with Chi-squared tests and the Student's t test. Power analysis indicated that 30 students were needed in each group. There were no significant differences between men and women in proper MDI-spacer technique.

<http://onlinelibrary.wiley.com/doi/10.1592/phco.20.17.1324.34892/abstract>

34. An Internet-based store-and-forward video home telehealth system for improving asthma outcomes in children

DS Chan, CW Callahan, SJ Sheets, et al.

American Journal of Health-System Pharmacy 1 Oct 2003;**60**(19):1976-1981

The adherence and disease-control outcomes associated with the use of an Internet-based store-and-forward video home telehealth system to manage asthma in children were studied. Paediatric patients with persistent asthma were provided with home computers and Internet access and monitored biweekly over the Internet. All patients were seen in the paediatric clinic at 0, 2, 6, 12 and 24 weeks. Half of the patients received asthma education in person and half via an interactive Web site. Adherence measures were assessed by therapeutic and diagnostic monitoring. Therapeutic monitoring included digital videos of patients using their controller medication inhaler. Diagnostic monitoring included an asthma symptom diary and a video of peak flow meter use. Videos were submitted electronically twice a week by using in-home telemonitoring with store-and-forward technology. Feedback was provided electronically to each patient. Disease control was assessed by examining quality of life, utilisation of services, rescue-therapy use, symptom control, satisfaction with home telemonitoring and retention of asthma knowledge. Patients were randomly assigned to an asthma education group (Internet vs office), and the data were analysed by comparing results for study days 0-90 and 91-180. Ten children participated. A total of 321 videos of inhaler use and 309 videos of peak flow meter use were submitted. Inhaler technique scores improved significantly in the second study period. Submission of diagnostic monitoring videos and asthma diary entries decreased significantly. Peak flow values as a percentage of personal best values increased significantly. Overall, there was no change in quality of life reported by patients. However, the caregivers in the virtual-education group reported an increase in the patients' quality-of-life survey scores. Emergency department visits and hospital admissions for asthma were avoided. Rescue therapy was infrequent. A high rate of satisfaction with home telemonitoring was reported. Internet-based, store-and-forward video assessment of children's use of asthma medications and monitoring tools in their homes appeared effective and well accepted.

<http://www.ajhp.org/content/60/19/1976.abstract>

35. Delivery characteristics and patients' handling of two single-dose dry-powder inhalers used in COPD

KR Chapman, CM Fogarty, C Peckitt, C Lassen, D Jadayel, J Dederichs, M Dalvi, B Kramer
International Journal of Chronic Obstructive Pulmonary Disease 23 Jun 2011;**6**:353-363

For optimal efficacy, an inhaler should deliver doses consistently and be easy for patients to use with minimal instruction. The delivery characteristics, patients' correct use, and preference of two single-dose dry powder inhalers (Breezhaler and HandiHaler) were evaluated in two complementary studies. The first study examined aerodynamic particle size distribution, using inhalation profiles of 7 patients with moderate to very severe chronic obstructive pulmonary disease (COPD). The second was an open-label, two-period, 7-day crossover study, evaluating use of the inhalers with placebo capsules by 82 patients with mild to severe COPD. Patients' correct use of the inhalers was assessed after reading written instructions on Day 1, and after training and 7 days of daily use. Patients' preference was assessed after completion of both study periods. Patient inhalation profiles showed average peak inspiratory

flows of 72 L/minute through Breezhaler and 36 L/minute through HandiHaler. For Breezhaler and HandiHaler, fine particle fractions were 27% and 10%, respectively. In the second study, correct use of Breezhaler and HandiHaler was achieved by more than 77% of patients for any step after 7 days; 61% of patients showed an overall preference for Breezhaler and 31% for HandiHaler (P = 0.01). Breezhaler is a low-resistance inhaler suitable for use by patients with a range of disease severities. Most patients used both inhalers correctly after 7 days, but more patients showed an overall preference for the Breezhaler compared with the HandiHaler. These are important factors for optimum dose delivery and successful COPD management.

<http://www.dovepress.com/getfile.php?fileID=10379>

36. Effect of an individualised education programme on asthma control, inhaler use skill, asthma knowledge and health-related quality of life among poorly compliant Korean adult patients with asthma

JY Choi, H-I Chu Chung

Journal of Clinical Nursing Jan 2011; **20**(1-2):119-126

Aims and objectives. This study assessed the effect of an individualised education programme on asthma control, inhaler use, asthma knowledge and health-related quality of life among poorly compliant adult Korean patients with asthma.

Background: Previous studies show that proper educational strategies are necessary to increase asthma knowledge and skills to improve patients' self-management and health-related quality of life.

Design: A one-group quasi-experimental design with repeated measurements.

Methods: Adult patients with asthma (n = 101) were recruited from University hospital located in K City, Korea. Three interventions consisting of 30-minute sessions of individualised education were provided by an education team. Peak expiratory flow rate (PEFR), daily record card (DRC) scores, skill scores for use of metered dose inhaler, level of asthma knowledge and health-related quality of life scores were obtained before the intervention and 2-4 and 4-8 weeks after the intervention. One-way repeated measures analysis of variance was used to identify the effect of the education programme on the dependent variables.

Results: Peak expiratory flow rate, DRC scores, inhaler using skill scores and health-related quality of life scores benefitted from intervention, whereas knowledge score did not. The effect on the PEFR and DRC score was sustained, with that of inhaler use skill increased over time from 4-8 weeks. However, the health-related quality of life effect was not sustained for 4-8 weeks after the intervention.

Conclusions: Repetitive education and innovative education methods may be needed to improve and to maintain pulmonary function, symptom control, asthma knowledge and health-related quality of life of poorly compliant adult Korean patients with asthma.

Relevance to clinical practice: This study confirmed the importance of education for patients suffering from asthma in managing their symptoms and promoting their quality of life.

<http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2702.2010.03420.x/abstract>

37. Not all asthma inhalers are the same: factors to consider when prescribing an inhaler

H Chrystyn, D Price

Primary Care Respiratory Journal Dec 2009; **18**(4):243-249

National and international asthma guidelines stress that before making changes to patients' therapy their compliance and inhaler technique should be checked. This review addresses these issues and highlights the differences between inhalers in terms of inhaler technique, individual ability/competence, and ease of use. The advantages and disadvantages of metered-dose inhalers (MDIs) and dry powder inhalers (DPIs) are presented. The reformulation of beclometasone MDIs is discussed since there has been some confusion over prescribing and Regulatory Authorities have recommended that these should be prescribed by brand name and not generically. This review should provide prescribers with an update to help them appreciate the differences between inhalers thereby optimising each patient's inhaled treatment.

http://www.thepcrj.org/journ/vol18/18_4_243_249.pdf

38. Educational practice for inhaled treatments in French cystic fibrosis care centers

A Clavel, A Deschildre, S Ravilly, M-C Simeoni, J-C Dubus

Journal of Aerosol Medicine Summer 2007;**20**(2):105-111

Inhaled treatments are very common in cystic fibrosis (CF) patients. We sent a questionnaire to the 49 French Cystic Fibrosis Care Centres (CFCCs) to see how the inhalation technique of CF patients was initiated and monitored (composition and formation of a potential educational team, use of a manual for use, amount of devices available for demonstration, education to disinfection procedure, realisation and frequency of inhalation technique monitoring, use of the patient's own device and frequency of checking when a paediatric patient transfers to an adult CFCC). Results were expressed in percent and compared with the test of the difference between two correlated proportions. Education for aerosol therapy was not performed in about 20% of the CFCCs. There was a specific member of staff for education in 33 CFCCs (68%). CFCCs owned statistically fewer nebulisers for demonstration than other devices. Disinfection advice was always given for nebulisers, but less frequently for spacers (80%) and dry powder inhalers (50%). The inhalation technique was monitored less than once a year or never in 22% of the cases, and rarely with the patient's own equipment. This monitoring was device dependent (56% with nebulisers vs 76% with the other devices, p less than 0.05). For nebulisers, monitoring depended on the presence of a member of staff responsible for education (p less than 0.01) and of a user manual ($p = 0.03$). When transferring to an adult CFCC, inhalation technique was checked in fewer than one-third of patients. Concludes that inhalation technique is poorly and insufficiently initiated and monitored in CF patients. Educational teams and programmes are urgently required.

<http://online.liebertpub.com/doi/abs/10.1089/jam.2007.0587>

39. Inhaled corticosteroids for asthma therapy: patient compliance, devices, and inhalation technique

MG Cochrane, MV Bala, KE Downs, J Mauskopf, RH Ben-Joseph

Chest Feb 2000;**117**(2):542-550

Background: Patient compliance, inhalation devices and inhalation techniques influence the effectiveness of inhaled medications.

Methods: This article presents the results of a systematic literature review of studies measuring compliance with inhaled corticosteroids, measuring inhalation technique with different inhalation devices, and estimating the proportion of inhaled drug that is deposited in the lung.

Results: Overall, patients took the recommended doses of inhaled medication on 20 to 73% of days. Frequency of efficient inhalation technique ranged from 46 to 59% of patients. Education programmes have been shown to improve compliance and inhalation techniques. The lung deposition achieved with different inhalers depends on particle size as well as inhaler technique.

Conclusions: This review demonstrates that multiple factors may come between a prescription of an inhaled corticosteroid and the arrival of that medicine at its target organ, the lung.

<http://chestjournal.chestpubs.org/content/117/2/542.abstract>

40. Assessment of a community pharmacy-based program for patients with asthma

M Cordina, JC McElnay, CM Hughes

Pharmacotherapy Oct 2001;**21**(10):1196-1203

Prospective, randomised, controlled trial in community pharmacies (11 control, 11 intervention) in Malta. A community-based pharmaceutical care programme was appreciated by the participants and had a positive impact on the vitality of patients with asthma, inhaler technique, and peak expiratory flow.

(Previously presented at the British Pharmaceutical Conference, Cardiff, 13-15 Sep 1999.)

<http://onlinelibrary.wiley.com/doi/10.1592/phco.21.15.1196.33894/abstract>

41. 2 year old asthmatics can learn to use a tube spacer by copying their mothers

RD Croft

Archives of Disease in Childhood May 1989;**64**(5):742-743

20 asthmatic children ages 1.9-2.9 years (mean 2.3 years) were given a tube spacer device (Volumatic, Allen & Hanbury). The mother was taught to operate the device but no attempt was made by hospital staff to instruct the child. After 2 months 15 of the 20 children had learnt to use the device correctly following tuition by the mother. Salbutamol inhaled through the device caused grimacing and coughing and 5 out of 13 studied were unable to tolerate it. The author concludes that this method of teaching is simple and effective and has not previously been emphasised. 2-year-old asthmatics can be expected to use tube spacer devices correctly.

<http://adc.bmj.com/content/64/5/742.abstract>

42. Problems patients have using their pressurised aerosol inhalers

GK Crompton

European Journal of Respiratory Diseases Supplement 1982;**63**:101-104

The use of pressurised aerosol inhalers was assessed in a total of 1173 outpatients attending hospital during a 3-month period. 135 patients already being treated with drugs by inhalation were found to have a poor inhaler technique, even though most had received instruction on how to use a pressurised aerosol and were considered to be able to use one of these devices correctly. 80 patients who had not used an inhaler before were found to be unable to use a pressurised aerosol efficiently after reading an instruction pamphlet or having the correct use of an aerosol demonstrated to them. 51% of patients studied were observed to have difficulty in co-ordinating aerosol release with inspiration. In 24% the release of aerosol into the mouth caused a halt of inspiration and in a further 12% the aerosol was actuated into the mouth, but inspiration was achieved through the nose with no air being drawn in through the mouth. 12% of patients already being treated with inhalers actuated the aerosol on two or more occasions during one inspiration.

43. The need to improve inhalation technique in Europe: a report from the Aerosol Drug Management Improvement Team

GK Crompton, PJ Barnes, M Broeders, C Corrigan, et al.

Respiratory Medicine Sep 2006; **100**(9):1479-1494

Although the principles of asthma management are well established in Europe, the available data indicate that asthma in patients is not well controlled. Many patients derive incomplete benefit from their inhaled medication because they do not use inhaler devices correctly and this may compromise asthma control. The Aerosol Drug Management Improvement Team (ADMIT), incorporating clinicians from the UK, Germany, France, Italy, Spain and the Netherlands, reviewed published evidence to examine ways to improve the treatment of reversible airways disease in Europe. Data indicate that there is a clear need for specific training of patients in correct inhalation technique for the various devices currently available, and this should be repeated frequently to maintain correct inhalation technique. Devices which provide reassurance to patients and their physicians that inhalation is performed correctly should help to improve patient compliance and asthma control. Educational efforts should also focus on primary prescribers of inhaler devices. ADMIT recommends dissemination of information on the correct inhalation technique for each model of device by the use of an accessible dedicated literature base or website which would enable to match the appropriate inhaler to the individual patient. There is also a need for standardisation of prescribing practices throughout Europe. Regular checking of inhalation technique by prescribers is crucial as correct inhalation is one of the keystones of successful asthma management.

<http://www.sciencedirect.com/science/article/pii/S0954611106000151>

44. Asthma inhalation delivery systems: the patient's viewpoint

S Cross

Journal of Aerosol Medicine Feb 2001; **14**(Suppl.1):3-7

International guidelines for asthma management state that inhalation is the preferred route of drug delivery. Consequently, it is important to select an appropriate delivery device and to take account of a patient's preference and lifestyle, as incorrect inhaler use may lead to treatment failure. A large number of devices are available from which to select, but it may be difficult for healthcare professionals to provide guidance to the patient unless they are familiar with the characteristics and correct use of each device. Many factors affect the success of a device in a patient's hands: the device's features; the patient's psychosocial status, cultural beliefs and language skills; and consistent instruction on inhalation technique. Constant education is essential to establish and maintain the patient's confidence in the treatment regimen. It is important that at least one member of the respiratory healthcare team should remain abreast of medical and pharmaceutical developments in the respiratory field. In this way, the choice of delivery device can be reviewed and changed to suit the changing needs of the patient.

<http://online.liebertpub.com/doi/abs/10.1089/08942680150506286>

45. Give elderly patients more help. An assessment of elderly patients' knowledge of their medication prior to discharge from hospital

C Crowley

Hospital Pharmacy Practice Dec 1994; **4**(11):453,454,456

Survey of 50 patients (31 f, 19 m; aged 75-95yr) being discharged from hospital wholly or partially self-medicating. Median number of items was 5 (range 1-9). Of the total 231 prescription items dispensed, 74.9% were correctly described, but accurate details of drug name and strength were given for only 25.5% and 7.4% of items respectively. Patients were often more certain about their drug therapy immediately prior to admission than about changes made in hospital. There were relatively few problems with packaging, but 8 patients could not read any labels used by the pharmacy unaided, and 7 could read only large print labels. Only 4 of 8 patients using inhalers had good technique, although all had been counselled on their use. 74% of patients felt they had received sufficient information about their medication. (14 refs.)

46. Assessment of patient performance of the HandiHaler® compared with the metered dose inhaler four weeks after instruction

R Dahl, V Backer, B Ollgaard, F Gerken, S Kesten

Respiratory Medicine Oct 2003;**97**(10):1126-1133

The HandiHaler® is a novel breath-actuated dry powder system designed for the delivery of tiotropium 18 microg daily in the treatment of COPD. We compared patient ability to use the HandiHaler® or metered dose inhaler (MDI) device correctly 4 weeks after receiving brief instructions and device demonstration. A single-blind study was conducted in COPD patients in two centres in Denmark. All patients (n =151) received one placebo capsule via the HandiHaler® daily and ipratropium (20 microg) two actuations via the MDI qid. Mean FEV1 for all patients was 1.25 +/- 0.54 (46% predicted). Twelve instructions establishing proper device use were evaluated for the MDI and Handihaler. Error scores were analysed by number of patients with less, equal or more errors when using HandiHaler® compared to MDI in the total efficacy population (n =139) and according to those who had not previously used an MDI for at least 12 months (MDI beginners) (n =74) and those who had used an MDI (MDI experienced) (n =65). 4 weeks after device instruction, a higher proportion of patients in the total population (P less than 0.01) had fewer errors with the HandiHaler® (35.3%) compared to the MDI (15.1%). The number of errors was equal in 50% of patients. Similar findings were observed in the subgroup of patients who were MDI beginners (42% vs 11%, P less than 0.01) with non-significant trends in favour of the HandiHaler® in those patients who were MDI experienced (29.7% vs 18.9%, P = 0.096). Similar results in favour of HandiHaler® were noted across different age and sex strata. The proportion of patients correctly using the device on the first of three attempts was 59.7% and 54.7% for the HandiHaler® and MDI, respectively (P = 0.399). In summary, use of the HandiHaler® can be easily taught with fewer errors compared to the MDI. Furthermore, patient performance using the HandiHaler® was superior to that with an MDI despite prior MDI experience and more frequent usage.

Several authors are with Boehringer Ingelheim.

<http://www.sciencedirect.com/science/article/pii/S0954611103001628>

47. Preliminary assessment of a computerised counselling program for asthmatic children

MJ Daly, S Jones

Pharmaceutical Journal 17 Aug 1991;**247**:206-208

Study of a computer program designed to counsel children with asthma, particularly in respect of the technique for using metered-dose inhalers. 64 subjects viewed the

program, including 22 asthmatic children (aged 10-13yr), 26 asthmatic adults and 16 non-asthmatic adults. (18 refs.)

48. Importance of assessment of metered-dose inhaler technique in the elderly

S Daniels, J Meuleman

Journal of the American Geriatrics Society Jan 1994;**42**:82-84

Case report of an 85-year-old male outpatient with a history of hypertension and infrequent asthma who failed to respond adequately to inhaled salbutamol (albuterol) and triamcinolone for about 9mo, until he was found to be using his metered dose inhalers incorrectly and was trained in the correct technique. The implications of poor MDI technique are discussed, and the authors emphasise that health professionals should not assume that others are instructing patients how to use their MDIs. (21 refs.)

49. Effect of pharmacist counseling on ambulatory patients' use of aerosolized bronchodilators

PL De Tullio, ME Corson

American Journal of Hospital Pharmacy Aug 1987;**44**(8):1802-1806

19 adult male outpatients with mild to moderate asthma or chronic obstructive pulmonary disease and who had been prescribed an orciprenaline, terbutaline, or salbutamol inhaler were assigned to a counselled or noncounselled group. 10 patients in the counselled group received detailed oral instruction on the use of the inhaler and its importance in the management of their disease. 11 steps necessary for proper inhaler technique were demonstrated and observed as the patient repeated the procedure. 9 patients in the non-counselled group were told only the name of the medicine, its purpose, and prescribed dosage. Both groups received a patient package insert. Use of the inhalers was evaluated by pulmonary function tests and the number of steps of the 11 step sequence carried out correctly. The results show that the counselled patients had a significantly higher increase in forced expiratory volume, and successfully completed more of the 11 step technique than did non-counselled patients.

<http://www.ajhp.org/content/44/8/1802.abstract>

50. Comparison of elderly people's technique in using two dry powder inhalers to deliver zanamivir: randomised controlled trial

P Diggory, C Fernandez, A Humphrey, V Jones, M Murphy

British Medical Journal 10 Mar 2001;**322**(7286):577-580

73 elderly patients in acute care wards at Mayday Hospital were randomised to use and tuition of the Relenza Diskhaler or the Turbohaler. After tuition, 50% of patients allocated the Diskhaler were unable to load and prime the device, and 65% were unable to do so 24 hours later. However, only 6% of those allocated the Turbohaler were unable to load and prime the device after initial review, and 3% after 24 hours. Concludes that most elderly people cannot use the Diskhaler inhaler device used to deliver zanamivir. (13 refs.)

<http://www.bmj.com/content/322/7286/577.full>

51. Treatment with inhaled steroids in asthma and chronic bronchitis: long- term compliance and inhaler technique

E Dompeling, PM Van Grunsven, CP Van Schayck, et al.

Family Practice Jun 1992;**9**(2):161-166

Compliance and inhaler technique were investigated in 50 patients in the Netherlands with airway obstruction (26 asthma, 24 chronic bronchitis) being treated with inhaled steroid (beclomethasone dipropionate, BDP) via a dry powder inhaler (Rotahaler omega). Patients had already participated for 1 year in a 2-year trial of BDP in general practice. They were treated daily with two dry powder inhalations of 400 microg BDP in combination with a bronchodilator. Compliance with BDP was measured by counting capsules (single-blind) at the end of a 4-month period and through a questionnaire. Counting capsules revealed non-compliance in 46% of the patients. Compliance was not related to age, sex, diagnosis or side-effects of BDP. In chronic bronchitis, but not in asthma, compliance was related to the outcome parameters of steroid treatment (pulmonary symptoms, change in lung function and non-specific bronchial responsiveness). The inhaler technique was judged insufficient in 27% of the patients. This study stresses the importance of regular instruction in inhaler technique and proper information about prophylactic steroid treatment by the general practitioner during the treatment of asthma and chronic bronchitis.

<http://fampra.oxfordjournals.org/content/9/2/161.abstract>

52. Training issues in the use of inhalers

M Duerden, D Price

Disease Management and Health Outcomes Feb 2001;**9**(2):75-87

Patient compliance and techniques used with inhalation devices can strongly influence the effectiveness of inhaled medications but these issues are often poorly recognised and may be neglected when these products are prescribed. The extent of these problems and the success of differing education and training programmes designed to improve inhaler technique have been evaluated by a review of the literature using Medline, EMBASE and Biosis Database from 1985 to date. Drug delivery to the airways to optimise clinical response and improve compliance is dependent on correct technique, which requires educational and motivational programmes aimed at patients and healthcare providers. Written instructions alone are often insufficient; practical demonstration is also required. Frequent reassessments and re-education for patients and healthcare professionals are necessary, as correct technique usually deteriorates over time. This all necessitates dedicated resources, which may be a problem in the current cost-containment climate. Treating acute symptoms immediately provides feedback on technique, but the intensive learning needed to reinforce correct inhaler technique may make the use of inhalers problematic for short treatment courses of acute diseases. To maximise therapeutic benefit from inhaled medications, long term educational programmes involving verbal and practical demonstrations must accompany inhaler use, and techniques should be frequently reassessed, particularly in children and the elderly. (103 refs.)

http://adisonline.com/diseasemanagement/Abstract/2001/09020/Training_Issues_in_the_Use_of_Inhalers.2.aspx

53. Inhaler use in patients with chronic obstructive pulmonary disease (COPD)

E Duran

6th Congress of the European Association of Hospital Pharmacists, Amsterdam, Netherlands, 21-23 Mar 2001, abstract book, p.23-24 (abstract)

Abstract of poster presentation. Interviews with 26 patients. Patients considered themselves sufficiently informed and that their techniques were appropriate. A large

percentage had never been informed by a health professional and made important mistakes.

54. 'Open-ended questions' and 'show-and-tell' - a way to improve pharmacist counselling and patients' handling of their medicines

A Ekedahl

Journal of Clinical Pharmacy and Therapeutics Apr 1996;**21**(2):95-99

An education programme was initiated in Sweden during 1990 in order to improve the communication skills of pharmacy staff and the information given to customers. Customers with prescriptions for Turbuhaler were asked to 'show-and-tell' how they used their inhalers, and the results were documented. In Apr 1992, 53% of patients handled their Turbuhaler correctly. One year later a significantly higher proportion of the patients (67%) used their inhalers correctly.

<http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2710.1996.tb00007.x/abstract>

55. Screening for incorrect inhaler use by regular users

MS Elfellah, L McDonald, A Thomson, A Smith

Pharmaceutical Journal 1 Oct 1994;**253**:467-468

A study was carried out on 94 patients (40-85 years) to measure the incidence of incorrect use of inhaler devices among patients who are regular users for chronic obstructive lung disease. 34 (36%) were found to use their inhaler devices incorrectly (95% CI, 26.5 to 46.7%). Of those 34 patients, 11 were counselled by the pharmacy - trained nursing staff and 23 were referred to a ward pharmacist for more extensive counselling. Of the 79 users of metered dose inhalers, 33 (42%) used them incorrectly. Of 15 users of breath-actuated devices, only one patient used them incorrectly (7%, p less than 0.01). The authors conclude that unacceptably high numbers of patients have incorrect technique. Treatment of patients could be improved by properly trained nurses assisting pharmacists in the screening and counselling of all patients with incorrect inhaler technique.

56. Pharmacists' understanding of patient education on metered-dose inhaler technique

SR Erickson, HM Landino, BJ Zarowitz, DM Kirking

Annals of Pharmacotherapy Nov 2000;**34**(11):1249-1256

Study based on a questionnaire completed before and 6 months after an educational intervention in pharmacies based in clinics owned by a healthcare system located in a large metropolitan area in the USA. Pharmacists reported they frequently educate patients and assess MDI technique for new prescriptions but not very often for patients recently started, as well as for long-term users. 6 months after an educational programme, attitudes and beliefs toward this activity were either not changed or, in some, improved. Pharmacists perceive that there is not enough time to assess and educate patients who use MDIs.

<http://www.theannals.com/content/34/11/1249.abstract>

57. Problems with inhaler use: a call for improved clinician and patient education

JB Fink, BK Rubin

Respiratory Care Oct 2005;**50**(10):1360-1375

Patient education is a critical factor in the use and misuse of medication inhalers. Inhalers represent advanced technology that is considered so easy to use that many

patients and clinicians do not receive adequate training in their use. Between 28% and 68% of patients do not use metered-dose inhalers or powder inhalers well enough to benefit from the prescribed medication, and 39 to 67% of nurses, doctors and respiratory therapists are unable to adequately describe or perform critical steps for using inhalers. Of an estimated US\$25 billion spent for inhalers annually, \$5-7 billion is wasted because of inhaler misuse. Reimbursement and teaching strategies to improve patient education could substantially reduce these wasted resources. Problems with inhaler use, the cost of inhalers, and myths associated with inhalers are reviewed, with recommendations for strategies and techniques to better educate patients in inhaler use. (62 refs.)

<http://docserver.ingentaconnect.com/deliver/connect/jrcc/00201324/v50n10/s6.pdf?expires=1332172669&id=67830636&titleid=72010044&accname=Guest+User&checksum=F123F66EEA93F03B4A20516440A26E86>

58. Individualized inhalation instruction using check sheets by a pharmacist in community pharmacy improves inhalation techniques in asthmatic patients

(article in Japanese)

S Fukuda, T Yoshinaga, N Hirata, Y Ishitsuka, M Irikura, T Irie, H Kohrogi
Aerugi Nov 2009; **58**(11):1521-1529

Background: Many types of inhaled medications are used for the treatment of asthma; however, inadequate inhalation techniques and poor adherence cause exacerbations of asthma symptoms. It is necessary to therefore provide adequate instruction to acquire correct inhalation techniques. This study aimed to evaluate the usefulness of individualized inhalation instruction in asthmatic outpatients by a community pharmacist for an improvement of the inhalation techniques and asthma control.

Methods: 28 asthmatic outpatients who have developed asthma over a long period and received prescriptions from Kumamoto Chuo Hospital from Apr to Aug 2008 were instructed by a pharmacist on inhalation techniques at Shimokawa Hamasen Pharmacy. Individual instruction by the pharmacist consisted of a skill-check with inhalers, followed by the use of a checklist of inhalation technique, a self-evaluation checklist and visual information for the patients. Outcomes were evaluated based on changes in inhalation technique mastery between their first visit and the subsequent visit. 19 of the 28 patients who completed the Asthma Control Test (ACT) were also evaluated for asthma control according to changes in their ACT scores.

Results: 20 patients showed inadequate inhalation techniques. The individualised instruction resulted in significant improvement in the inhalation techniques. Moreover, there were significant improvements in the ACT scores (from 19.1 to 21.4) of 19 patients who received the individualised instruction.

Conclusions: Individualised instruction of asthmatic outpatients enables them to improve their inhalation techniques, improving their asthmatic symptoms. We suggest that coordination with hospital and community pharmacy improves therapeutic outcomes in inhaled medication for the asthmatic outpatients.

<http://jja.jsaweb.jp/full/058111521.pdf>

59. Is the inhaler technique associated with asthma control?

V Garcia-Cardenas, D Sabater-Hernandez, MJ Faus, F Martinez-Martinez, SI Benrimoj
Journal of Asthma Mar 2012; **49**(2):170-171

<http://informahealthcare.com/doi/abs/10.3109/02770903.2011.654025>

60. Errors in Turbuhaler technique in a Spanish population of asthmatic patients

V Garcia-Cardenas, D Sabater-Hernandez, JP Garcia-Corpas, MJ Faus, F Martinez-Martinez, SI Benrimoj

Respiratory Care May 2012;**57**(5):817-819

Letter commenting on a paper by IA Basheti et al. (*Respiratory Care* Dec 2011;**56**(12):1916-1923) and presenting data from Spain. The original authors reply.

<http://www.rcjournal.com/contents/05.12/contents.cfm>

61. Inadequate use of pressurized aerosols by asthmatic patients

(Mauvaise utilisation des aerosol-doseurs par les asthmatiques)

P Gayraud, J Orehek

Respiration 1980;**40**(1):47-52

The purpose of this study was to determine in a population of asthmatics, the number of patients who correctly used the pressurised aerosols (bronchodilator drugs or steroids) spontaneously, or after training sessions. 115 asthmatics (in- or outpatients, 14-70 years old) were asked to use their inhaler in the presence of an observer. The inhalation technique was considered correct when (1) the puff release was coordinated with a deep inspiration and (2) when the inspiration was followed by a few seconds' breath-holding. The patients were divided into two groups: a trained group of 46 patients who were observed for 1 month or more after the two above-mentioned manoeuvres had been demonstrated to them by a physician and the need for correct use strongly emphasised. The other group (the untrained group) comprised 69 patients who were presumably using their inhalers according to the manufacturer's instructions: (1) expiration; (2) inspiration and actuation, and (3) breath-holding. In the trained group 52% of the patients were classified by the observer as correct users, as compared to 28% in the untrained group. The results were not influenced by sex, age or occupational differences. These observations suggest that a majority of asthmatics probably derived incomplete benefit from the use of pressurised aerosols. Although training apparently results in a more efficient use of the inhalers, this study shows that training sessions must be repeated, and the results checked at regular intervals by a member of the medical staff. In subjects who repeatedly fail to achieve a correct inhalation technique the drug should be given by another route.

62. A prospective observational study of patient training in use of the Autohaler inhaler device: the Sirocco study

V Giraud, F-A Allaert, A Magnan

European Review for Medical and Pharmacological Sciences May 2011;**15**(5):563-570

Background: Asthma guidelines recommend that patients receive inhaler technique training, with rechecks at each visit. However, suboptimal inhaler technique is common.

Methods: This prospective observational study evaluated patient training in use of the Autohaler, a breath-actuated metered-dose inhaler. Physicians enrolled the first four consecutive, eligible adult patients receiving inhaled corticosteroid therapy for asthma. Patients demonstrated their inhaler technique after seeing a demonstration of proper technique and again after physicians gave verbal instruction addressing individual difficulties in technique. Their first and last attempts were evaluated using a 12-item checklist comprising 7 consecutive steps for correct inhaler use and 5 potential errors in device handling or inhalation manoeuvre.

Results: A total of 1723 physicians (91% general practitioners) enrolled 6512 patients (mean age 43 years, 52% male). On their first attempt, 2561/6387 (40.1%) of patients were able to complete all procedural steps correctly and without error. A poor inhalation manoeuvre was the most common cause of failure in technique. After education, 91.4% of patients were able to complete all procedural steps correctly and without error. Training session median length was 4 minutes (range 0-45 minutes).

Conclusions: Practical training, coupled with demonstration of inhaler use and observation of technique by a physician, can help patients to improve their inhaler technique and appears feasible in every day practice. Further work is needed to evaluate whether patients maintain good inhaler technique and whether physicians continue the training sessions in everyday practice.

<http://www.europeanreview.org/article/947>

63. Inhaler technique and asthma: feasibility and acceptability of training by pharmacists

V Giraud, F-A Allaert, N Roche

Respiratory Medicine Dec 2011; **105**(12):1815-1822

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 1 month after training, were assessed.

Of 727 patients receiving training at pharmacies in France (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 or higher) at baseline was significantly (p less than 0.05) and independently associated with poor inhaler technique and poor self-reported adherence (Morisky score = 3 or higher). The percentage of patients with optimal inhaler technique rose from 24% before to 79% after training (p less than 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 less than 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 seems to improve inhaler technique, asthma control and adherence.

[http://www.resmedjournal.com/article/S0954-6111\(11\)00218-6/abstract](http://www.resmedjournal.com/article/S0954-6111(11)00218-6/abstract)

64. The influence of age, diagnosis, and gender on proper use of metered-dose inhalers

DE Goodman, E Israel, M Rosenberg, R Johnston, ST Weiss, JM Drazen

American Journal of Respiratory and Critical Care Medicine Nov 1994; **150**(5):1256-1261

Metered dose inhalers (MDIs) are widely used in clinical practice for administering pharmaceuticals targeted to the lung. It is well known that the inhalation technique used with MDIs can substantially influence the clinical response to inhaled medications. To determine the acceptability of MDI manoeuvres, we studied 59 subjects (26 females and 33 males; aged 20-81 years; mean age, 38 years) to

determine whether the MDI technique used by these individuals complied with published recommendations for acceptable inhalation technique. Measurements were made with an MDI adapter that contained an unobtrusive, lightweight, miniature sensing system. Inspiratory flow at the moment of MDI actuation (V_a), the volume (integrated from airflow) at actuation as a fraction of total inspiratory volume (V_a/V_I), breath-holding time (tBH), and inspiratory volume as a fraction of FVC (V_I/FVC) were determined from 59 uncoached inhalations. We defined an acceptable manoeuvre, based on published data, by four components: (1) inspiratory flow at actuation (V_a) between 25 and 90 L/min; (2) actuation during early inspiration (V_a/V_I between 0 and 0.20); (3) adequate breath-holding time (tBH longer than 4 s), and (4) a deep inhalation (V_I/FVC greater than 0.50). For all subjects, only 25% of inhalation manoeuvres met all four criteria for acceptability. We found that a significantly higher proportion of male than female subjects performed an acceptable MDI manoeuvre (43% vs 4%, p less than 0.001). There were no significant differences in technique between younger and older subjects or between patients with a diagnosis of asthma or chronic obstructive pulmonary disease (COPD). We conclude that most patients use their MDIs incorrectly; females of all ages are much more likely to have improper MDI technique than are males.

<http://ajrccm.atsjournals.org/content/150/5/1256.abstract>

65. Inhaler technique in Turkish people with poor English: a case of information discrimination?

L Goodyer, I Savage, Z Dikmen

Pharmacy World and Science Apr 2006;**28**(2):107-114

Objectives: (a) To compare metered dose inhaler (MDI) technique in users with poor English and fluent English, (b) to evaluate two interventions: a translated patient information leaflet (PIL) plus support from a translator (PIL + verbal) and a multimedia touch screen system (MTS) using video clips and own-language instruction.

Methods: (a) Inhaler technique was videotaped and key steps rated blind for 105 fluent English-speakers (FE) and 69 Turkish-speakers with poor English (EP). (b) The EP group was randomised to receive information by MTS ($n = 34$) or PIL + verbal ($n = 35$). Inhaler technique was videotaped before and after information.

Main outcome measures: (a) Global inhaler technique; (b) breathing-in time; (c) co-ordination of inspiration and inhaler actuation.

Results: Global technique, co-ordination and breath-holding were all significantly worse in MDI users with poor English. Only 17% of that group had adequate technique compared to over half (62%) of FE. The EP group were significantly less likely than the FE group to report ever seeing the practice nurse about their asthma. After information, global technique was rated as improved in 50% of the MTS group compared to 28% of those given a translated PIL. A further 6 people (17%) in the PIL group improved after subsequent verbal advice in their own language. Both information methods significantly increased inhaler shaking and mouthpiece checking, but co-ordination only improved in a small number of people.

Conclusions: The study suggests that Turkish-speaking MDI users with poor English may be disadvantaged in terms of access to medicines information in the UK. The acceptability of pharmacy-based support services for this, and other specific language groups should be explored. Multimedia offers an alternative to a translator for brief explanations, particularly for first-time users, but improving poor co-ordination requires individualised 'hands on' teaching from health professionals.

<http://www.springerlink.com/content/b5742q11067706n4/>

66. Assessment of interrater and intrarater reliability in the evaluation of metered dose inhaler technique

SL Gray, AC Nance, DM Williams, CC Pulliam

Chest Mar 1994;**105**(3):710-714

Study Objective: To determine if a training session using videotaped metered dose inhaler (MDI) performances can result in high interrater and intrarater reliability of 5 evaluators assessing MDI technique.

Design: Five evaluators (3 pharmacists, 2 pulmonary fellows) were trained to evaluate MDI technique during a 2-hour training session. The training session consisted of verbal instruction and practical experience in evaluating MDI technique using video-taped MDI performances of six non-study subjects. After the training session, the evaluators independently observed the same videotaped MDI demonstrations of 14 subjects on two occasions separated by a 7- to 10-day interval. Interrater and intrarater reliability was determined for individual steps by calculating percentage agreement and intraclass correlation (ICC) coefficient.

Results: Interrater. The interrater reliability for individual steps ranged from 29 to 86% (ICC coefficient = 0.13 to 0.81). Steps in which evaluators were in agreement for less than 9 of the 14 subjects were shaking the inhaler before inhalation, exhaling, continuing to inhale slowly and adequate breath hold. Intrarater: The overall percentage agreement by step ranged from 74 to 97%. Exhaling to functional residual volume (76%) and continuing to inhale slowly and deeply (74%) had the lowest overall agreement between the first and second observation day. The consistency of evaluating a step between the two observation days varied considerably depending on the step and evaluator.

Conclusions: High interrater and intrarater reliability in MDI evaluation is difficult to obtain. Clinicians and researchers involved in MDI evaluation and education should be trained to achieve consistency. A single training session using videotaped MDI demonstrations was not adequate in achieving consistency among evaluators. To improve accuracy of research results, researchers should include at least two evaluators to assess MDI technique or take other measures to show and report reliability.

<http://chestjournal.chestpubs.org/content/105/3/710.short>

67. Assessment of inhalation technique in children in general practice: increased risk of incorrect performance with new device

W Hagmolen of ten Have, NJ van de Berg, PJE Bindels, WMC van Aalderen, J van der Palen
Journal of Asthma 2008;**45**(1):67-71

In a general practice-based population in the Netherlands, 76% of 530 children inhaling asthma medication inhaled correctly. However, important differences among inhalers were found. Children with a pressurised metered-dose inhaler without a spacer device performed worst, with only 22% inhaling without essential errors. At a second evaluation of the inhaler technique, 1 year after the first assessment, performances with a new device were more often incorrect versus the unchanged devices (21.1% and 10.8%, respectively; $p = 0.01$). Providing children with a new device should be carefully controlled over time especially because these children are error prone.

<http://informahealthcare.com/doi/abs/10.1080/02770900701815834>

68. Pharmacist-led intervention study to improve inhalation technique in asthma and COPD patients

A Hammerlein, U Muller, M Schulz

Journal of Evaluation in Clinical Practice Feb 2010;**17**(1):61-70

Rationale and Aims: Inhaled therapy is the mainstay of treatment in patients with asthma and chronic obstructive pulmonary disease (COPD). For effectiveness of pharmacotherapy, correct use of medication is required. The aims of this study were to survey the quality of inhalation technique in patients and to determine the effect of a single intervention in community pharmacies by means of standardised procedures.

Methods: A total of 757 patients with asthma or COPD were randomly selected by 55 community pharmacies in Germany. At baseline, patients were interviewed and their inhalation technique was assessed with a 21-item checklist. Any error was recorded and, if necessary, patients were instructed in the proper use of their device. After 4-6 weeks, demonstration of inhalation technique was repeated in the community pharmacies and a pre-post comparison was performed.

Results: A total of 597 patients (78.9%) made at least one mistake in performing the inhalation technique at baseline. This number dropped to 214 (28.3%) from the first to the second appointment. All patients benefited from the pharmacists' intervention regardless of their former training experiences.

Conclusions: Inhalation technique of asthma and COPD patients is poor. In daily practice, community pharmacy-based pharmacists are well suited to significantly supplement doctor-based education in inhalation technique.

<http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2753.2010.01369.x/abstract>

69. Medical personnel's knowledge of and ability to use inhaling devices. Metered-dose inhalers, spacing chambers, and breath-actuated dry powder inhalers

NA Hanania, R Wittman, S Kesten, KR Chapman

Chest Jan 1994;**105**(1):111-116

Background: Current treatment strategies for asthma and chronic obstructive pulmonary disease (COPD) emphasise the inhalation route, yet patients often misuse metered-dose inhalers (MDI). To address this problem, patient education by medical personnel has been recommended and a variety of alternative inhaler devices has been developed.

Methods: We surveyed medical personnel at a Canadian hospital to assess their knowledge of and ability to use three widely used inhaler devices; MDI, MDI with a spacing chamber (Aerochamber, Trudell Medical, Canada), and a breath-actuated multidose dry powder inhaler (Turbuhaler, Astra Pharma, Canada). 30 respiratory therapists (RT), 30 registered nurses (RN) and 30 medical house staff physicians (MD) were asked to demonstrate the use of each device using placebo inhalers and to answer 11 clinically relevant questions related to the use and maintenance of the tested devices.

Results: The RT's percentage mean knowledge score (67 +/- 5%) was significantly higher than those achieved by either the RNs (39 +/- 7%) or the MDs (48 +/- 7%) (for all p less than 0.0001). Similarly, percentage mean demonstration scores for each device were significantly higher for RTs than either RN or MD groups; for MDI, 97 +/- 3% versus 82 +/- 13% and 69 +/- 24%, respectively (p less than 0.0001); for the Aerochamber, 98 +/- 2% versus 78 +/- 20% and 57 +/- 31% (p less than 0.0001); and for the Turbuhaler, 60 +/- 30% versus 12 +/- 23% and 21 +/- 30% (p less than 0.0001). Knowledge of and practical skills with the devices were roughly

proportional to the length of time the device had been in clinical use, Turbuhaler demonstration scores being lower than either MDI or Aerochamber scores ($p = 0.05$ and $p = 0.09$, respectively). More RTs (77%) had received formal instruction on the use of devices at school than either RNs (30%) or MDs (43%) (p less than 0.05). Conclusions: We conclude that (1) many medical personnel responsible for monitoring and instructing patients in optimal inhaler use lack rudimentary skills with these devices, (2) nurses and physicians seldom receive formal training in the use of inhaling devices, and (3) newer inhaling devices designed to obviate problems of technique are at present less likely to be used well by medical personnel soon after their introduction.

<http://chestjournal.chestpubs.org/content/105/1/111.full.pdf+html>

70. Technique training does not improve the ability of most patients to use pressurised metered-dose inhalers (pMDIs)

A Hardwell, V Barber, T Hargadon, E McKnight, J Holmes, ML Levy

Primary Care Respiratory Journal Mar 2011;**20**(1):92-96

Aims: According to guidelines, inhaler technique should be tested in all patients, particularly those with poorly controlled asthma. We aimed to assess uncontrolled asthma patients' ability to use a pressurised metered-dose inhaler (pMDI) using the Aerosol Inhalation Monitor (AIM, © Vitalograph).

Methods: Practices invited patients for a detailed clinical review by trained asthma nurses according to practice-agreed protocols. Reviews took place from 1 Apr to 30 Jun 2008, and included checking of inhaler technique. Reasons for invitations included, time since last review, asthma control, prescriptions, adherence to medical advice. A proxy measure of control – the total number of short-acting beta2-agonist (SABA) bronchodilator inhaler canisters prescribed in the previous 12 months – was used. Data on 77 pre-determined clinical parameters (including prescribing and healthcare utilisation data) were collected. Patient-completed postal symptom questionnaires (the RCP 3 questions) were obtained in some patients. All patients using pMDIs had at least two assessments using the AIM, and where appropriate inhaler technique education was provided.

Results: 2123 (24% of those invited) symptomatic asthma patients were reviewed; 1291 (61%) were using pMDIs (mean age 52 years; SD 21), of whom over 80% were in BTS/SIGN Steps 2 and 3. 1092 (85.6%) of those patients using pMDIs failed the first AIM assessment. There was a significant increase in the number of patients able to use their pMDIs correctly following instruction after the second (129 to 260 of 1197 patients, p less than 0.01) and third (61 to 181 of 528 patients, p less than 0.01) tests. However, 78.4% and 65.7% of those tested twice and three times, respectively, failed the AIM assessment despite instruction. Logistic regression analysis failed to show any effect of age and BTS step on these outcomes.

Conclusions: A majority of symptomatic asthma patients in this study were unable to use pMDIs correctly. It is essential to check all patients' ability to use their prescribed inhalers regularly. Cost alone should not determine prescribing recommendations.

http://www.thepcrj.org/journ/vol20/20_1_92_96.pdf

71. Incorrect inhaler technique compromising quality of life of asthmatic patients

A Hashmi, JA Soomro, A Memon, TK Soomro

Journal of Medicine 2012;**13**(1):16-21

Introduction: The inhalation route is widely used for the treatment of asthma. It is considered that inadequate inhaler technique is the leading cause of therapy failure.
Objective: To determine the proportion of incorrect inhaler use and associated factors in asthmatic patients compromising quality of life.

Methodology: A cross-sectional study conducted at the specialist chest clinic of Fatima Bhai Hospital, Karachi, Pakistan, from Sep 2010 to Mar 2011. A sample size of 215 was selected by non-probability purposive sampling technique. Trained health care workers in the presence of a chest specialist requested patients to demonstrate their inhaler technique and assessed it according to the checklist. If any of the steps was missing or done incorrectly, it was marked as incorrect technique. Information was also collected through a structured questionnaire on socio-demographic variables such as age, gender, education, duration of asthma, duration of inhaler use and patient education in inhaler technique. Data were entered and analysed using SPSS-14.

Results: There was an inverse relationship between education level and incorrect inhaler technique (p less than 0.05). Education of inhaler usage provided by doctors was more effective as compared to education provided by nurses (p less than 0.038). There was no significant relationship between age, sex, duration of asthma, duration of inhaler use or frequency of inhaler use and incorrect inhaler technique.

Conclusions: Quality of life of a large percentage of patients is compromised by incorrect inhaler use and the education level of patients had a significant relationship with incorrect inhaler technique.

<http://www.banglajol.info/index.php/JOM/article/view/7980>

72. Choosing inhaler devices for people with asthma: current knowledge and outstanding research needs

J Haughney, D Price, NC Barnes, JC Virchow, N Roche, H Chrystyn
Respiratory Medicine Sep 2010;**104**(9):1237-1245

Recommendations in asthma guidelines presuppose that practitioners have the evidence, information, knowledge and tools to select inhaler devices appropriate for individual patients. Randomised controlled trials usually exclude patients with suboptimal inhaler technique. There is therefore little evidence on which to base inhaler selection in the real world, where patients often use their inhalers incorrectly. The lung deposition of inhaled drug varies according to inhaler device, drug particle size, inhalation technique and pattern of inspiratory flow. Even with training, not all patients can use their inhalers correctly and maintain inhaler technique; patients may have inability to handle the inhaler, strong negative preferences or natural breathing patterns that do not match their prescribed inhaler. Therefore, matching device to the patient may be a better course of action than increasing therapy or training and retraining a patient to use a specific inhaler device. Several research questions require answers to meet the goal of helping prescribers make a more informed choice of inhaler type. Is the level of drug deposition in the lungs a key determinant of clinical short- and long-term outcomes? What should be measured by a clinical tool designed to check inhaler technique and therefore help with device selection? If we have a tool to help in individualising inhaler choice, will we achieve better asthma outcomes? Do we have to refine inhaler device choice for each individual, or will we get better outcomes if we select our current best option in light of current knowledge and apply this on a population level?

[http://www.resmedjournal.com/article/S0954-6111\(10\)00191-5/abstract](http://www.resmedjournal.com/article/S0954-6111(10)00191-5/abstract)

73. Handling of a spacer (Babyhaler®) for inhalation therapy in 0- to 3-year-old children

HJE Hendriks, PC Overberg, HJL Brackel, NA Vermue

Journal of Asthma 1998;**35**(3):297-304

The handling of the Babyhaler® spacer for inhalation therapy in children 0-3 years old with asthma was tested and the perceptions of the investigators with the instruction of this device to the parents was investigated. It was an open, multicentre study of 182 patients with a treatment period of 2 weeks and a 2-week follow-up period. Thirty paediatricians in Dutch local and university hospitals participated. Using standardised instructions, the purpose and the application of the Babyhaler were explained and demonstrated, and parents were asked to use the Babyhaler on their own child. The quality of the demonstration was scored and, if necessary, additional instruction was given. In the following treatment period of 2 weeks a record card was completed; the convenience score of the Babyhaler and the symptom score were recorded. At the following evaluation visit the handling of the Babyhaler by the parents was re-evaluated. 89% of the parents could use the Babyhaler correctly after one instruction. The instructions of the Babyhaler were considered to be easy in 83% of the cases by the parents and the investigators. During the treatment period the handling score (6 = impossible to use, 1 = very easy) improved from 2.4 to 1.7. At the evaluation visit the correct use was similar to the result at the instruction visit (87%). No differences were found in the ease of handling between the three age groups (0-1, 1-2 and 2-3 years). The application of inhalation therapy via the Babyhaler was favoured by 92% of the parents as compared to the former treatment method. The authors conclude that the Babyhaler is easy to use by the parents and that the instruction of the device by practitioners is also perceived as easy.

<http://informahealthcare.com/doi/abs/10.3109/02770909809068221>

74. Comparison of conventional metered dose inhaler and breath actuated inhaler in elderly patients

A Hendry, J Coote, H Black, G Duncan, JB MacDonald

International Journal of Pharmacy Practice Mar 1995;**3**(2):115-118

Prospective crossover study in 44 elderly patients (27 women, 17 men; aged 64-94 years) with chronic obstructive pulmonary disease or asthma, who were already receiving inhaled beta-agonist bronchodilator therapy. Patients were given salbutamol via metered dose inhaler (MDI) or breath-actuated inhaler (BAI) for periods of 4 weeks each in random order. Standardised tuition was given before use of each inhaler, and assessment and tuition was repeated weekly through each period. More patients (11/30) had an inefficient technique after using the MDI for 4 weeks than after using the BAI for 4 weeks (3/30). Slightly fewer patients liked the BAI but the differences were not significant. The authors conclude the BAI was easier to use than a MDI by elderly patients, especially those with co-morbidities, and was less bulky than a MDI plus spacer. While the greater cost of the BAI would discourage first-line use, it may be preferable for patients unable to achieve a satisfactory technique using a conventional MDI. (19 refs.)

<http://onlinelibrary.wiley.com/doi/10.1111/j.2042-7174.1995.tb00801.x/abstract>

75. An audit of the extent of inhaler counselling by community pharmacists in Dumfries and Galloway

IM Heslop, A Cairns, T Carson, et al.

Pharmaceutical Journal 10 Sep 1994;**253**(6806):350-351

An audit project was carried out over 12 months to find out to what extent community pharmacists were involved in the counselling of patients, and to identify and rectify some of the impediments to inhaler counselling. One limitation was a lack of placebo devices for demonstrating technique. (4 refs.)

76. Determinants of an incorrect inhalation technique in patients with asthma or COPD

AE Hesselink, BWJH Penninx, HAH Wijnhoven, DMW Kriegsman, JTM van Eijk
Scandinavian Journal of Primary Health Care 2001;**19**(4):255-260

Objective: To determine the prevalence of an incorrect inhalation technique and to examine its determinants among primary care patients with asthma or chronic obstructive pulmonary disease (COPD).

Design: Cross-sectional study.

Setting: 28 general practitioners in the Netherlands.

Subjects: 558 asthma and COPD patients, aged 16-75 years.

Main Outcome Measures: Inhalation technique was assessed using a standardised inhaler-specific checklist. Pulmonary function assessment and questionnaires were used to collect data about inhaler, patient and disease characteristics.

Results: Overall, 24.2% of the patients made at least one essential mistake in their inhalation technique. The type of inhaler appeared to be the strongest independent determinant of an incorrect inhalation technique. Compared to patients using the Diskhaler, patients using the Rotahaler/Spinhaler, Turbuhaler, Metered Dose Inhaler (MDI) or Cyclohaler/Inhaler-Ingelheim were at significantly higher risk of making inhalation mistakes (odds ratios (OR) were 16.08, 13.17, 11.60 and 3.27, respectively). Other significant determinants of an incorrect inhalation technique were low emotional quality of life (OR = 1.73) and being treated in a group practice (OR = 2.26).

Conclusions: An incorrect inhalation technique is common among pulmonary disease patients in primary care. Our study suggests that especially patients using the Rotahaler/Spinhaler, Turbuhaler or MDI, patients with emotional problems and patients in a group practice are at increased risk for an incorrect inhalation technique.

<http://informahealthcare.com/doi/abs/10.1080/02813430152706792>

77. An audit of inhaler technique among asthma patients of 34 general practitioners

S Hilton

British Journal of General Practice Dec 1990;**40**(341):505-506

Doctors from 34 practices participated in an audit study which examined inhaler technique in up to 20 of their patients. A new scoring system, applicable to all forms of device, was used. Although the majority of the 422 patients (63%) was using metered dose inhalers, a broad range of other devices was included; most frequently Rotahalers (15%) and spacer devices (9%). For analysis, technique scores were rated as 'good' (score 4 out of 4), 'adequate' (score 3 or 4) and 'inadequate' (score 2 or less). Overall, 25% of patients had inadequate technique. Of all devices, the Turbuhaler had the highest proportion of patients with good technique (78%), and metered dose inhalers the lowest (45%). This audit confirms that technique is unsatisfactory for a significant proportion of patients, regardless of the device used.

A simple scoring system promotes consistent testing of technique within a practice.

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1371448/pdf/brjgenprac00073-0025.pdf>

78. Pharmacist counselling of the optimal inhaler technique

M Hindle

Pharmaceutical Journal 24 Oct 1992;**249**(Suppl):R11

Poster presented at the British Pharmaceutical Conference 1992.

This study compared 2 techniques for using a salbutamol metered dose inhaler by measuring the 30 min urine excretion of salbutamol. Pharmacodynamic and pharmacokinetic parameters were then measured pre- and post-counselling in the optimal technique.

79. Inhaler technique in older people in the community

SF Ho, MS O'Mahony, JA Steward, P Brea, ML Burr

Age and Ageing Mar 2004;**33**(2):185-188

Background: good inhaler technique and medication concordance is important for symptom and disease control in chronic airways disease.

Objectives: establish the prevalence of inhaler use; the main inhaler devices used by older people at home; their ability to use the inhalers they have been prescribed; and the relationship between perceived ease of use and actual performance.

Design: cross-sectional population based study.

Subjects: subjects aged 70 years and over living at home.

Methods: 500 subjects were randomly selected from 5002 subjects aged 70 years and over living at home. Inhalers used over the previous 24 hours were identified by a nurse on home visit. Those with cognitive impairment were excluded. Inhaler system was assessed and graded by a doctor as acceptable (perfect or minor errors) or unacceptable (major errors), using previously published criteria. Perceived ease of use of the device was rated as easy, moderate or difficult.

Results: 423 subjects participated in the study. The population prevalence of inhaler use was 15.8% (12.0, 19.7). Of the 91 inhaler devices used, 39 (42.8%) were metered dose inhalers, 34 (37.4%) were metered dose inhalers with large volume spacers and 18 (19.8%) were breath-actuated devices. 32 subjects (82.1%) using metered dose inhalers had an acceptable technique compared with 33 (97.1%) of those using metered dose inhalers with large volume spacers and 13 (72.2%) of those using breath-actuated devices (P less than 0.05). Up to three-quarters of inhalers were considered easy to use but 12% of subjects who rated their inhaler device as being easy to use made major errors.

Conclusions: Metered dose inhaler was the most frequently prescribed inhaler and was used correctly by most subjects especially in combination with large volume spacers. Major errors were more common with breath-actuated devices. Inhaler technique should be checked as patients' perception of their inhaler skills correlates poorly with actual performance.

<http://ageing.oxfordjournals.org/content/33/2/185.full.pdf+html>

80. Development of a patient counselling manual on inhalers and inhaler technique

R Homer-Ward

Hospital Pharmacy Practice Dec 1992;**2**:755-760

Describes the development of a checklist for counselling patients in the use of metered-dose aerosol inhalers, and the results of an assessment of the ability of pharmacists and pharmacy technicians to counsel patients correctly. The author notes that leaflets currently in circulation do not include additional information on inhalers. (8 refs.)

81. Designing and implementing a COPD discharge care bundle

NS Hopkinson, C Englebretsen, N Cooley, K Kennie, M Lim, et al.

Thorax Jan 2012;**67**(1):90-92

National surveys have revealed significant differences in patient outcomes following admission to hospital with acute exacerbation of COPD which are likely to be due to variations in care. We developed a care bundle for use in inner north-west London, comprising a short list of evidence-based practices to be implemented prior to discharge for all patients admitted with this condition, based on a review of national guidelines and other relevant literature, expert opinion and patient consultation. Implementation was then piloted using action research methodologies with patient input. Actively involving staff was vital to ensure that the changes introduced were understood and the process followed. Implementation of a care bundle has the potential to produce a dramatic improvement in compliance with optimum health care practice.

Reports that 'the care bundle was launched on the respiratory ward at a series of multidisciplinary meetings. A survey of ward staff during the development of the project had revealed low levels of confidence regarding inhaler technique, smoking cessation and pulmonary rehabilitation, so it was clear that staff education would be important. An initial barrier to this was that it was difficult for the staff to attend teaching sessions in a group without impeding clinical work. We developed an educational model where members of the team would spend time on the ward at a stand providing teaching about topics such as smoking cessation and inhaler technique in a 'drop in' way. Thus, during the course of a shift all the nurses on the ward had the opportunity to be educated with minimal disruption. This led to improved confidence in these areas, which was confirmed by a staff survey. Pharmacists involved in the project took the opportunity to teach on a daily basis and developed laminated pictorial charts to attach to the drug trolley to reinforce the correct inhaler techniques required.'

<http://thorax.bmj.com/content/67/1/90.full.pdf+html>

82. Risk factors for inadequate use of pressurized aerosol inhalers

MG Horsley, GR Baillie

Journal of Clinical Pharmacy and Therapeutics Apr 1988;**13**(2):139-143

86 patients were studied to determine the sources of error in patient use of pressurised aerosol inhalers (PAIs), the risk factors for poor technique, and the effect of instruction of patients on PAI technique. Patients were assessed before and after instruction using a standard procedure. Critical initial assessment showed that 31% of patients had an adequate technique. 75 patients were reassessed after instruction, and 72% of these were determined to be adequate users. The most common errors were failure to breath-hold after inhalation, failure to exhale prior to inhalation, and poor coordination of aerosol administration with the start of inhalation. Elderly patients were consistently poor users. Technique improved with more PAIs being used, but duration of PAI use was not a significant factor.

<http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2710.1988.tb00170.x/abstract>

83. Metered-dose inhalers: do health care providers know what to teach?

B Interiano, KK Guntupalli

Archives of Internal Medicine 11 Jan 1993;**153**(1):81-85

Objective: The specific aim of this investigation was to evaluate the proficiency of health care providers and patients in the proper use of metered-dose inhalers.

Design, Setting and Participants: Health care providers, which include house staff, nurses and respiratory care practitioners who provide care to patients with asthma in the primary general medicine clinic or the pulmonary medicine clinic of a university-county hospital in the USA in which patients were referred, were surveyed and assigned a performance score regarding the knowledge base of the appropriate use of metered-dose inhalers. Patients who attended the primary care general medicine and pulmonary subspecialty clinic were also assessed as to their proficiency in the use of metered-dose inhalers.

Results: A significant percentage of patients had a poor understanding of the technique used with the metered-dose inhaler. House staff and nursing staff were also less proficient in the proper use of the metered-dose inhaler. The respiratory care practitioners were the most knowledgeable of the health care providers.

Conclusions: This study confirms that a large percentage of patients use metered-dose inhalers improperly. It also demonstrates a significant lack of understanding by health care providers of the proper use of metered-dose inhalers. Furthermore, this study supports the use of respiratory care practitioners in the outpatient setting, since they were the most proficient among all the health care providers in the proper use of metered-dose inhalers.

<http://archinte.ama-assn.org/cgi/content/abstract/153/1/81>

84. Inhaler education for hospital-based pharmacists: how much is required?

CA Jackevicius, KR Chapman

Canadian Respiratory Journal May-Jun 1999;6(3):237-244

Objective: To compare the effectiveness of a more intensive educational intervention with a less intensive intervention on the ability of hospital pharmacists to be prepared to educate patients regarding inhaled device technique.

Design: Randomised, controlled trial. Inhaler technique and knowledge were assessed pre-education, immediately after and 3 months after education by a research assistant blinded to the educational allocation.

Setting: Tertiary hospital pharmacy department.

Population Studied: Hospital-based pharmacists.

Intervention: A 1-hour 'hands-on' session with feedback (more intense education, MIE) or written materials describing inhaler use (less intense education, LIE).

Main Results: The change in overall score from pre-education to early post-education for MIE was greater than for LIE (mean; 95% CI) (2.64; 1.27 to 4.01 versus 1.26; 0.05 to 2.47; P less than 0.001). Assessment scores improved for all device demonstrations and general knowledge. The change in score from the pre-education to the late post-education period was only slightly higher in the MIE group than the LIE group, a difference that was not statistically significant (1.78; 0.82 to 2.74 versus 1.22; 0.06 to 2.39; P = 0.09). Scores in both groups were lower in the late post-education period compared with the early post-education period. Greater increases in total score in the immediate post-education period were associated with a low baseline score and the MIE intervention.

Conclusions: Individual coaching in inhaler technique produces greater improvement in inhaler knowledge among hospital pharmacists than provision of written materials. However, the advantage of the more intensive intervention was short-lived, with little advantage evident in 3 months.

<http://www.pulsus.com/journals/abstract.jsp?HCTYPE=Physician&CurrPg=journal&jnlKy=4&atlKy=3391&isuKy=315&isArt=t&>

85. Asthmatic children's inhalation techniques in general practice

CLW Janssen, AS Spoelstra, MM Brueren

European Journal of General Practice Dec 2003;**9**(4):143-145

Study of inhaler technique among paediatric patients in 7 Dutch general practices which reveals the extent of the problem and calls for GPs to be more attentive to inhaler technique in their paediatric patients.

<http://informahealthcare.com/doi/abs/10.3109/13814780309160424>

86. Comparison of effects of a self management booklet and audiocassette for patients with asthma

D Jenkinson, J Davison, P Hawtin

British Medical Journal 23 Jul 1988;**297**(6643):267

After a 6-month run-in period, 206 asthmatics were randomly allocated into one of 4 groups. Group 1 acted as controls. Group 2 were given a book containing educational material about self management of asthma. Group 3 were given an audiocassette tape of similar material and Group 4 were given both. A wide range of parameters was assessed in the patients after a further 3 months and at 12 months, 4 scoring systems were devised to measure patients' knowledge and use of drugs, consultation with their doctor, morbidity, perceptions of their disability and the use of the educational material. 177 patients completed the study (reasons for drop out given). After the run-in period, mean scores for knowledge on drugs were similar between two groups. The greatest changes in scores at 3 and 12 months were in the groups using the tape and book or tape alone. Drug use and skill in using inhalers, morbidity or consultation did not change. Perception of disability fell in groups receiving the material. Patients preferred the book to the tape, but the tape had greatest effect.

http://www.bmj.com/highwire/filestream/311514/field_highwire_article_pdf/0.pdf

87. Medicine use reviews reduce asthma admissions

P Jerram

Pharmacy Management Jul 2009;**25**(3):15-19

The Isle of Wight Primary Care Trust has defined three categories of medicine use reviews (MUR): standard, directed and supported (MUR Plus). Describes the first directed MUR to be implemented by the PCT, which was for patient respiratory inhaler technique assessment. The project has resulted in reductions of cost and prescription numbers for short-acting selective beta agonists (relievers) and to a reduction of more than 50% in emergency hospital admissions for asthma over a 3-month period. (22 refs.)

88. Evaluation of inhaler usage technique and response to educational training in a tertiary health care centre

GP Jolly, A Mahmood, A Mohan, RM Pandey

American Journal of Respiratory and Critical Care Medicine 1 May 2012;**185**(Suppl):A3328

Paper presented at the American Thoracic Society 2012 International Conference, San Francisco, California, USA, 18-23 May 2012.

http://ajrccm.atsjournals.org/cgi/content/short/185/1_MeetingAbstracts/A3328?rss=1

89. A comparison of large volume spacer, breath-activated and dry powder inhalers in older people

V Jones, C Fernandez, P Diggory

Age and Ageing Sep 1999;**28**(5):481-484

Aims: To see if elderly people can use the breath-activated (Easi-breathe) and dry powder (Turbohaler) inhalers as effectively as the metered-dose inhaler and Volumatic system.

Methods: 102 inhaler-naive patients (aged 75-101 years, mean 84 years), without cognitive impairment, were randomly allocated one of Easi-breathe, Turbohaler or metered-dose inhaler and Volumatic placebo inhalers. Standardised tuition was done on enrolment and at 6-hour review. Inhaler technique was assessed immediately after enrolment tuition and at 6 and 24 hours. Assessment was by scoring (0 = poor, 1 = moderate, 2 = perfect) five aspects of technique.

Results: Mean total scores were significantly (P less than 0.005) higher for Turbohaler and Easi-breathe than metered-dose inhaler and Volumatic on enrolment and 6 hours and at 24 hours (P less than 0.045). Fewer patients achieved excellent scores of 9 or 10 when using metered-dose inhaler and Volumatic. The main difficulties were in assembling the metered-dose inhaler and Volumatic and detecting when the metered-dose inhaler and Volumatic or Easi-breathe was empty.

Conclusions: Breath-activated and dry powder inhalers were more likely to be used correctly than metered-dose inhalers with large volume spacers.

<http://ageing.oxfordjournals.org/content/28/5/481.abstract>

90. The relevance of political prestudies for implementation studies of cognitive services in community pharmacies

S Kaae, J Morgall Traulsen, B Sondergaard, L Stig Haugbolle

Research in Social and Administrative Pharmacy Jun 2009;**5**(2):189-194

Studies of cognitive services implementation in the pharmacy sector traditionally focus on individual and/or organisational factors to explain why some pharmacies are successful and others are not. The social and political context of the origins of these services is rarely part of the analysis. The aim of this article is to argue for the inclusion of political pre-studies as part of the study design for implementation studies on reimbursed services in community pharmacy. A political pre-study of the Inhaler Technique Assessment Service (ITAS) introduced in Denmark in 2004 serves as an example of this approach and is described in detail. Political pre-studies were shown to be a useful prerequisite when designing implementation studies of cognitive services in community pharmacies and can provide valuable insight into the ultimate success or failure of these services.

<http://www.sciencedirect.com/science/article/pii/S1551741108000521>

91. How to engage experienced medicine users at the counter for a pharmacy-based asthma inhaler service

S Kaae, L Stig Nørgaard

International Journal of Pharmacy Practice Apr 2012;**20**(2):99-106

Objectives: Recent studies have identified recruitment of customers at the pharmacy counter as a limiter to successful provision of cognitive services in community pharmacies especially that of experienced customers with refill prescriptions. The aim of the paper is to gain insight into current problems of recruiting.

Methods: A qualitative study was conducted based on semi-structured interviews with 12 participants in a project in 2010 aimed at optimising recruitment of

experienced asthma patients for the Inhaler Technique Assessment Service in Denmark. An ad hoc analysis was applied in order to interpret pharmacy staff perceptions of experienced asthma patients in comparison with newly diagnosed patients and to categorise the types of developed recruitment strategies as to whether they reflected a technical or everyday-life perspective on medicine. Key Findings: Effective recruitment processes were found to follow a generic pattern which consisted of a special type of opening question followed by providing a justification for the service. The participants perceived that the main difference between experienced and newly diagnosed patients was their degree of knowledge about their condition or correct inhaler technique. Most questions, and especially those related to reasons for motivating the customer to accept the service, were dominated by a professional technical understanding of medicine. In particular, follow-up justification based on a life-world perspective needs to be developed further. The identified type of communication might prevent some customers from accepting the service as they are not motivated by technical arguments but rather by how their daily symptoms can be relieved.

Conclusions: Pharmacy staff should focus both on adequate opening questions as well follow-up justification when trying to recruit customers for cognitive services. The study might inform future studies on how to create new and more adequate strategies for recruitment of customers for relevant cognitive services in community pharmacies.

<http://onlinelibrary.wiley.com/doi/10.1111/j.2042-7174.2011.00170.x/abstract>

92. Sustaining delivery of the first publicly reimbursed cognitive service in Denmark: a cross-case analysis

S Kaae, B Sondergaard, L Stig Haugbolle, et al.

International Journal of Pharmacy Practice 2010; **18**(1):21-27

The aim was to identify local organisational factors that affect sustained delivery of the first Danish publicly reimbursed cognitive service, the Inhaler Technique Assessment Service (ITAS). The ITAS is a 10-min interactive counselling session during which pharmacy staff assess the inhalation technique of individual asthma patients at the pharmacy counter, and correct any errors

Qualitative methods included field observations, semi-structured interviews, group interviews and the collecting of documentary material. Data-source and method triangulation were applied. Seven pharmacies were included in the study.

Pharmacies with sustained delivery had introduced systematic evaluations of the local delivery of the ITAS and made ongoing efforts to improve staff competencies. Pharmacy staff in general rarely assessed patients' clinical needs before offering the service and rarely provided follow-up. Thus, pharmacy staff failed to utilise the full clinical potential of the ITAS.

To conclude, human resource leadership techniques would be useful in achieving this aim, as would focusing on the service by providing systematic evaluations.

<http://onlinelibrary.wiley.com/doi/10.1211/ijpp.18.01.0005/abstract>

93. The Inhalation Manager: a new computer-based device to assess inhalation technique and drug delivery to the patient

WES Kamin, T Genz, S Roeder, et al.

Journal of Aerosol Medicine Mar 2003; **16**(1):21-29

Describes the development of a new system, the Inhalation Manager, which, for the first time, offers the possibility of assessing the entire inhalation manoeuvre of patients using original devices under everyday conditions. So far the Inhalation

Manager allows the measurement of inspiratory manoeuvres of patients through placebo inhalation devices of the most common breath-actuated CFC-free inhalers in the market for the three main glucocorticosteroids budesonide (Turbohaler (TH), dry powder inhaler (DPI)), beclomethasone dipropionate (Autohaler (AH), breath-actuated pressurised metered dose inhaler (pMDI)), and fluticasone propionate (Diskus (DI), DPI) by means of a pneumotachometer. In addition, it allows the expected drug delivery values (mass output and particle size distribution) of individual manoeuvres to be allocated for these three devices. In a field trial, the inhalation technique of 628 (TH), 794 (AH) and 795 (DI) patients, respectively, was tested in 72 pulmonologist practices with the Inhalation Manager. For patients in the 18-59-year-old group, the Inhalation Manager detected the following percentages needing improvement: 1.5% for the Autohaler device, 16.7% for the Diskus and 38.9% for the Turbohaler. In the 60-99-year-old group, percentages needing improvement were 1.5%, 31.5%, and 66.1% for the Autohaler, Diskus and Turbohaler, respectively. Therefore, the Inhalation Manager could become an essential tool in asthma management by finding the most suitable inhaler for an individual patient and by training in the optimal inhalation technique.

<http://online.liebertpub.com/doi/abs/10.1089/089426803764928329>

94. Determinants of correct inhalation technique in children attending a hospital-based asthma clinic

AWA Kamps, PLP Brand, RJ Roorda

Acta Paediatrica Feb 2002;**91**(2):159-163

200 children with asthma demonstrated their inhalation technique. Patient characteristics and the components of inhalation instructions they had received were compared for children demonstrating a correct or incorrect inhalation technique. In addition, the inhalation technique of 47 newly referred patients was followed-up prospectively after repeated comprehensive instruction sessions. 78% of all patients demonstrated a correct inhalation technique. Patients who had received repeated instruction sessions and patients who had previously been asked to demonstrate the use of their inhaler during an instruction session were more likely than other children to demonstrate a correct inhalation technique (p less than 0.001 and $p = 0.03$, respectively). Multiple logistic regression analysis showed that repetition of instructions was significantly associated with a correct inhalation technique (odds ratio (OR) 8.2, 95% CI 3.2- 21.5; p less than 0.0001) irrespective of type of inhaler used. Demonstration of the inhaler use by the patient was significantly associated with a correct inhalation technique for patients using a metered dose inhaler plus spacer device (OR 3.5, 95% CI 1.0-12.6; $p = 0.05$), but not for patients using a dry powder inhaler (OR 1.6, 95% CI 0.4-6.4; $p = 0.54$). The number of newly referred patients demonstrating a correct inhalation technique improved from 57.4% to 97.9% after three comprehensive instruction sessions. The authors conclude that inhalation instruction should be given repeatedly to achieve and maintain correct inhalation technique in asthmatic children.

<http://onlinelibrary.wiley.com/doi/10.1111/j.1651-2227.2002.tb01688.x/abstract>

95. Poor inhalation technique, even after inhalation instructions, in children with asthma

AW Kamps, B van Ewijk, RJ Roorda, PL Brand

Pediatric Pulmonology Jan 2000;**29**(1):39-42

The aim of this study was to evaluate the effect of instructions to children with asthma (given by general practitioners or by pharmacy assistants) on how to inhale

from metered dose inhalers with spacers (MDI/s) or dry powder inhalers (DPI). We scored inhalation technique of asthmatic children according to criteria defined by the Netherlands Asthma Foundation, and related the performance to the inhalation instructions given. For each inhaler, a number of steps were considered essential for reliable drug delivery. Patients newly referred for asthma were asked to demonstrate their inhalation technique and to fill out a questionnaire on the inhalation instruction received prior to referral. Children participating in a clinical trial, who had received repeated comprehensive inhalation instructions, served as a control group.

66 newly referred patients (1-14 years of age, median age 5 years; 37 boys) and 29 control patients (5-10 years of age, median age 7 years; 21 boys) completed the study. 60 patients (91%) had received inhalation instruction prior to referral. Only 29% of these patients, using a dry powder inhaler, performed all essential steps correctly, compared to 67% of children using a metered dose inhaler/spacer combination (P less than 0.01). Children who had received comprehensive inhalation instructions with repeated checks of proper inhalation technique at the pharmacy or in the clinical trial setting were more likely to perform all essential steps correctly (79% and 93%, respectively) than children who had received a single instruction by a general practitioner (39%, P less than 0.01).

Authors conclude that many asthmatic children use their inhaler devices too poorly to result in reliable drug delivery, even after inhalation instruction. Comprehensive inhalation instruction and repeated check-ups are needed to assure reliable inhalation technique.

[http://onlinelibrary.wiley.com/doi/10.1002/\(SICI\)1099-0496\(200001\)29:1%3C39::AID-PPUL7%3E3.0.CO;2-G/abstract](http://onlinelibrary.wiley.com/doi/10.1002/(SICI)1099-0496(200001)29:1%3C39::AID-PPUL7%3E3.0.CO;2-G/abstract)

96. Correct aerosol medication use and the health professions. Who will teach the teachers?

HW Kelly

Chest Dec 1993; **104**(6):1648-1649

Editorial referring to a paper by Kesten et al. (p.1737-1742, Reference 97) and emphasising the value of community pharmacists in counselling patients who are prescribed inhalers in primary care.

<http://chestjournal.chestpubs.org/content/104/6/1648.full.pdf+html>

97. Pharmacist knowledge and ability to use inhaled medication delivery systems

S Kesten, K Zive, KR Chapman

Chest Dec 1993; **104**(6):1737-1742

Previous studies have shown that a significant proportion of patients and physicians have difficulty using metered dose inhaler (MDI) delivery systems. It has been suggested that paramedical personnel such as pharmacists could address this problem by serving as patient educators. Few studies have assessed a pharmacist's knowledge of and ability to use inhaled devices, including not only the conventional MDI but newer devices such as an add-on spacing chamber (Aerochamber) and a multidose dry powder inhaler (Turbuhaler). The authors therefore approached all pharmacists in a predefined geographic area of a large Canadian city in order to evaluate their knowledge of and ability to use inhaled medications. Of 62 pharmacists approached, 45 (73%) agreed to participate. Ability to use the conventional MDI, Aerochamber (A), and Turbuhaler (T) was graded by a trained observer using a checklist of 11 essential steps. The percentage of pharmacists

performing greater than 6, 8 and 10 steps correctly for each device was MDI = 96%, 87%, 62%; MDI + A = 80%, 76%, 47%; T = 67%, 64%, 29%. The most common problems with the MDI were forgetting to shake prior to use and coordinating inspiration with actuation. The most common problems with the MDI + A were forgetting to shake prior to use, remembering to inspire after actuation, and breath holding after inspiration. The most common difficulty with the T was total unfamiliarity with the device with 33% of pharmacists achieving less than 2 steps correctly. The observer subsequently administered a questionnaire of 11 clinically relevant questions for each of the devices tested. The mean score was 50% with only 21% of pharmacists scoring above 70%. 33% of respondents had no instruction in device use beyond reading the package insert; 40% had received instruction from a pharmaceutical representative; only 24% had received instructions from professional school. Concludes that a pharmacist's knowledge of inhaling devices is roughly proportional to the length of time the device has been available and that pharmacists form another group of health care professionals who require further teaching regarding inhaled medication delivery systems.

See also Reference 96.

<http://chestjournal.chestpubs.org/content/104/6/1737.abstract>

98. The effect of patient education on correct use of metered dose inhalers in patients with asthma

SG Kim, AS Jang, YK Kim, S Lee, JP Seo, et al.

Korean Journal of Asthma, Allergy and Clinical Immunology Oct 2000; **20**(5):695-701

Background: Medications for asthma can be administered either by inhaled or systemic routes. The major advantages of delivering drugs directly into the lungs via inhalation are that higher concentrations can be delivered more effectively to the airways and that systemic side effects are avoided or minimised. Inhaled medications, or aerosols, are available in a variety of devices that differ in required technique and quantity of drugs delivered to the lung.

Objective: The purpose of this study was to determine the effects of patient education on correct use of metered dose inhaler in patients with asthma.

Methods: 20 Korean patients with asthma were instructed three times on proper inhaler usage by a physician at 2-week intervals. Practical performance and theoretical knowledge were assessed (10-item assessment). Scoring was done by one physician using a score of 1-3 for each item.

Results: The practical performance and theoretical knowledge scores were higher in patients after being instructed three times compared with those who were instructed once (26.2 +/- 2.2 vs 18.1 +/- 3.6, p less than 0.01). The scores were higher in patients with higher education level compared with those with lower education level after three lessons (27.3 +/- 1.94 vs 24.3 +/- 1.80, p less than 0.05). The most common errors included inadequate actuation time and breath holding, and insufficient activations.

Conclusions: These findings suggest that patients with asthma should be instructed in inhaler use and that their technique be checked regularly and repeatedly depending on their education level.

<http://www.komci.org/GSResult.php?RID=0058JAACI/2000.20.5.695&DT=1>

99. Inappropriate techniques used by internal medicine residents with three kinds of inhalers (a metered dose inhaler, Diskus, and Turbuhaler): changes after a single teaching session

S-H Kim, HJ Kwak, T-B Kim, Y-S Chang, J-W Jeong, C-W Kim, HJ Yoon, YK Jee
Journal of Asthma Nov 2009;**46**(9):944-950

Background: While initial education and regular evaluation of inhaler technique in patients are emphasised in the management of asthma and chronic obstructive pulmonary disease, health care professionals are not experienced in using inhalers. This study assessed whether internal medicine residents used common inhalers correctly and whether a single teaching session successfully improved their performance.

Methods: We evaluated 142 internal medicine residents from six university hospitals in Korea for their techniques with three different inhaler devices: a metered dose inhaler (MDI), Diskus and Turbuhaler. We assessed whether participants completed each step in using the three inhalers and classified overall performance as good, adequate or inadequate for each inhaler type. To estimate the effect of a single teaching session, reassessment was performed 2 months after education.

Results: Performance grade was inadequate for 50.7% of participants with a MDI, 43.0% for Diskus and 51.4% for Turbuhaler. An early year of residency was associated significantly with inappropriate technique for Diskus ($p = 0.003$), but not for MDI and Turbuhaler. After a single teaching session, overall skills improved significantly for all three inhalers. The proportion of subjects with good or adequate skill changed notably from 39.7% to 83.8% for MDI ($p = 0.001$), from 50.0% to 86.8% for Diskus ($p = 0.001$) and from 44.1% to 88.2% for Turbuhaler ($p = 0.001$).
Conclusions: These findings demonstrate that a high proportion of internal medicine residents cannot use inhalers correctly and just a single teaching can effectively enhance their inhaler technique.

<http://informahealthcare.com/doi/abs/10.3109/02770900903229701>

100. A randomized controlled trial of a literacy-sensitive self-management intervention for chronic obstructive pulmonary disease patients

K Kiser, D Jonas, Z Warner, K Scanlon, B Bryant Shilliday, DA DeWalt
Journal of General Internal Medicine Sep 2011;**27**(2):190-195

Background: Low literacy skills are common and associated with a variety of poor health outcomes. This may be particularly important in patients with chronic illnesses such as chronic obstructive pulmonary disease (COPD) that require appropriate inhaler technique to maintain quality of life and avoid exacerbations.

Objective: To explore the impact of a literacy-sensitive self-management intervention on inhaler technique scores in COPD patients and to determine if effects differ by literacy.

Design: Randomised controlled trial.

Participants: 99 patients with COPD in the USA.

Intervention: Patients were randomly assigned to a one-on-one self-management educational intervention or usual care. The intervention focused on inhaler technique, smoking cessation and using a COPD action plan.

Main Measures: At baseline, an inhaler technique assessment, literacy assessment, health-related quality of life questionnaires and pulmonary function tests were completed. Inhaler technique was re-evaluated after 2 to 8 weeks.

Key Results: Mean age 63, 65% female, 69% Caucasian, moderate COPD severity on average, 36% with low literacy, moderately impaired health-related quality of life, and similar baseline metered dose inhaler technique scores. Patients in the intervention group had greater mean improvement from baseline in metered dose inhaler technique score compared to those in the usual care group (difference in

mean change 2.1; 95% CI, 1.1 to 3.0). The patients in the intervention group also had greater mean improvements in metered dose inhaler technique score than those in the usual care group whether they had low health literacy (difference in mean change 2.8; 95% CI, 0.6 to 4.9) or higher health literacy (1.8; 95% CI, 0.7 to 2.9). Conclusions: A literacy-sensitive self-management intervention can lead to improvements in inhaler technique, with benefits for patients with both low and higher health literacy.

<http://www.springerlink.com/content/a189181p38583h51/>

101. Teaching inhaler use in chronic obstructive pulmonary disease patients

SC Lareau, R Hodder

Journal of the American Academy of Nurse Practitioners Feb 2012;**24**(2):113-120

Purpose: To review barriers to the successful use of inhalers in patients with chronic obstructive pulmonary disease (COPD), and the role of the nurse practitioner (NP) in facilitating optimum inhaler use.

Data sources: Review of the national and international scientific literature.

Conclusions: Pharmacological treatment of COPD patients comprises mainly inhaled medications. Incorrect use of inhalers is very common in these individuals. Some of the consequences of poor inhaler technique include reduced therapeutic dosing, medication adherence and disease stability, which can lead to increased morbidity, decreased quality of life and a high burden on the healthcare system.

Knowledgeable evaluation and frequent reassessment of inhaler use coupled with education of patients, caregivers and healthcare professionals can significantly improve the benefits COPD patients derive from inhaled therapy.

Implications for practice: Patient education is vital for correct use of inhalers and to ensure the effectiveness of inhaled medications. The NP has a critical role in assessing potential barriers to successful learning by the patient and improving inhaler technique and medication management. The NP can also facilitate success with inhaled medications by providing up-to-date inhaler education for other healthcare team members, who may then act as patient educators.

<http://onlinelibrary.wiley.com/doi/10.1111/j.1745-7599.2011.00681.x/abstract>

102. The ADMIT series – Issues in Inhalation Therapy. 6) Training tools for inhalation devices

F Lavorini, ML Levy, C Corrigan, G Crompton (ADMIT Working Group)

Primary Care Respiratory Journal Dec 2010;**19**(4):335-341

Inhaled medications are the preferred therapies for patients with asthma and COPD, but their effectiveness is limited by the patient's ability to use the device properly, an issue often neglected when these medications are prescribed. Correct inhaler technique must be taught and learnt, and requires educational and motivational programmes aimed at patients and healthcare providers alike. Written instructions alone are manifestly insufficient: education must include practical demonstration and periodic re-assessment and re-education, since correct technique and motivation usually deteriorate with time. Several devices are available on the market, the purpose of which is to train patients to use inhalers correctly. They are often directed at particular devices or groups of devices and/or particular critical aspects of technique. This paper reviews the devices currently available for training patients in the correct use of both pressurised metered-dose inhalers (pMDIs) and dry powder inhalers (DPIs).

http://www.thepcrj.org/journ/view_article.php?article_id=749

103. Effect of incorrect use of dry powder inhalers on management of patients with asthma and COPD

F Lavorini, A Magnan, JC Dubus, et al.

Respiratory Medicine Apr 2008; **102**(4):593-604

This article presents the results of a systematic literature review of studies evaluating incorrect use of established dry powder inhalers (DPIs) by patients with asthma or chronic obstructive pulmonary disease (COPD). Overall, it was found that between 4% and 94% of patients, depending on the type of inhaler and method of assessment, do not use their inhalers correctly. The most common errors made included failure to exhale before actuation, failure to breath-hold after inhalation, incorrect positioning of the inhaler, incorrect rotation sequence, and failure to execute a forceful and deep inhalation. Inefficient DPI technique may lead to insufficient drug delivery and hence to insufficient lung deposition. As many as 25% of patients have never received verbal inhaler technique instruction, and for those that do, the quality and duration of instruction is not adequate and not reinforced by follow-up checks. Concludes that the review demonstrates that incorrect DPI technique with established DPIs is common among patients with asthma and COPD, and suggests that poor inhalation technique has detrimental consequences for clinical efficacy. Regular assessment and reinforcement of correct inhalation technique are considered by health professionals and caregivers to be an essential component of successful asthma management. Improvement of asthma and COPD management could be achieved by new DPIs that are easy to use correctly and are forgiving of poor inhalation technique, thus ensuring more successful drug delivery.

[http://www.resmedjournal.com/article/S0954-6111\(07\)00447-7/abstract](http://www.resmedjournal.com/article/S0954-6111(07)00447-7/abstract)

104. Influence of particle size and patient dosing technique on lung deposition of HFA-beclomethasone from a metered dose inhaler

CL Leach, PJ Davidson, BE Hasselquist, RJ Boudreau

Journal of Aerosol Medicine Winter 2005; **18**(4):379-385

The objective of this study was to determine the lung delivery of HFA-134a-beclomethasone dipropionate (HFA-BDP) from a breath-activated inhaler (QVAR™ Autohaler™) compared with proper and improper press and breathe (QVAR™ P&B) metered dose inhaler (MDI) technique. The hypothesis was that the smaller particles of BDP from HFA-BDP would stay suspended longer in the inspiratory air of patients and thus reduce the deleterious effects of inhaler discoordination. The study was an open label, 4-period, crossover design. Asthmatic patients (n = 7) with a history of asthma symptoms, an FEV-1 of more than 70% of predicted normal, and a history of reversibility to a beta-agonist of 12% or more were utilised. BDP was radiolabelled with technetium-99m and delivered from the QVAR Autohaler or QVAR P+B device in patients trained to reproducibly utilise coordinated and discoordinated P+B MDI technique. Patients using Autohaler MDI exhibited 60% lung deposition of BDP. Patients using coordinated technique with the P+B MDI exhibited 59% lung deposition. Patients trained to consistently actuate the P+B MDI before inhaling exhibited 37% lung deposition. Patients trained to consistently actuate the P+B MDI late in the inspiration (i.e. 1.5 sec into a 3-sec inspiration) exhibited 50% lung deposition. In conclusion, the breath-activated Autohaler automatically provided optimal BDP lung deposition of 60%. Patients with good P+B MDI technique also received optimal lung deposition of 59%. The degree of lung deposition was decreased as patients demonstrated poor inhaler technique. However patients with poor technique still received a large lung dose of BDP (i.e. 37% or more) compared

with lung deposition values of 4% to 7% for CFC-BDP MDIs previously published and confirmed in this study.

Some of the authors are with 3M Pharmaceuticals.

<http://online.liebertpub.com/doi/abs/10.1089/jam.2005.18.379>

105. Evaluating the effectiveness of consultant pharmacists' education on the proper use of metered-dose inhalers and breath-actuated inhalers

RE Learned

Consultant Pharmacist Jun 1999;**14**:658-661

Medication inhalers are an increasingly important tool for asthma and pulmonary disease care, but their effectiveness often hinges on nurses' ability to use the devices properly. Results of this intervention study indicate that an educational intervention conducted by a consultant pharmacist can enhance nurses' knowledge and proper use of inhalers.

106. Aerosol inhalation teaching device

H Lee, HE Evans

Journal of Pediatrics Feb 1987;**110**(2):249-252

Detailed description and diagrammatic representation of a device to teach inhalation technique to asthmatic children. The jacket of a canister nebuliser is modified so that inhalation is accompanied by a horn sound and a light is turned on when the canister is actuated. The device allows the child to differentiate between inhalation and exhalation and oral vs nasal inhalation. Two studies were used to evaluate the teaching aid 1) 33 children (6-16yr), 13 were 'beginners' (ie had never used a canister nebuliser) and 20 had been 'incorrect users' for 2 months to 3 years 2) 22 children (7-18yr), 11 'beginners' and 11 'incorrect users'. In study 1), verbal instruction and demonstration for 10min resulted in 30% learning the technique. Of the other 60% (23), 20 learned the technique after 10min instruction with the teaching device; the other 3 took 11, 20 and 28min. One child required 3 teaching sessions before the technique was retained. In study 2), all children were taught with the device; 17 learned the technique within 10min, the other 5 within 12-15min. At retesting at 1-4 weeks, all except 1 child still had correct technique. 77% of those taught with the device achieved correct technique within 10min compared to 30% of those taught in conventional manner. The device is inexpensive, easy to construct and can be used for non-English-speaking patients. Retesting is necessary to ensure that the correct technique is retained.

[http://www.jpeds.com/article/S0022-3476\(87\)80163-4/abstract](http://www.jpeds.com/article/S0022-3476(87)80163-4/abstract)

107. Skills in handling Turbuhaler, Diskus, and pressurized metered-dose inhaler in Korean asthmatic patients

SM Lee, Y-S Chang, C-W Kim, T-B Kim, et al.

Allergy, Asthma and Immunology Research Jan 2011;**3**(1):46-52

Purpose: The objective of this study was to evaluate skills in handling inhalers and factors associated with these skills among patients with asthma who had undergone treatment at special asthma and allergy clinics in Korea.

Methods: We enrolled 78 subjects who used Turbuhaler and 145 who used Diskus for asthma control at special clinics in 10 university hospitals and visually assessed their skills in handling these inhalers. We also evaluated skills in 137 subjects who had used pressurised metered-dose inhalers (pMDIs) for symptom relief. Age, sex,

duration of asthma and inhaler use, smoking status, monthly income, highest grade completed in school and previous instruction for handling inhalers were also measured to evaluate their association with overall inhaler skills.

Results: Performance grade was inadequate for 12.8% of participants using Turbuhaler, 6.2% for Diskus, and 23.4% for pMDIs. The success rates for each step in handling the inhalers were relatively high except for the 'exhale slowly to residual volume' step, in which success rates ranged from 24.2% to 28.5%. Older age, male sex, lower educational grade and absence of previous instruction for handling inhalers were associated with inadequate inhaler technique in univariate analysis; however, only older age and absence of previous instruction remained significant independent risk factors in multivariate analysis.

Conclusions: Among Korean asthmatic patients in special asthma and allergy clinics, skills in handling their inhalers were mostly excellent; meanwhile, older age and absence of previous instruction for handling inhalers were associated with inadequate techniques.

<http://e-aair.org/Synapse/Data/PDFData/9999AAIR/aair-3-46.pdf>

108. Inappropriate inhaler use: assessment of use and patient preference of seven inhalation devices

J Lenney, JA Innes, GK Crompton

Respiratory Medicine May 2000;**94**(5):496-500

Inefficient inhaler technique is a common problem resulting in poor drug delivery, decreased disease control and increased inhaler use. The aim of this study was to assess patients' use of different inhaler devices and to ascertain whether patient preference is indicative of ease of use and whether current inhaler use has any influence on either technique or preference. We also wished to define the most appropriate method of selecting an inhaler for a patient, taking into account observed technique and device cost. 100 patients received instruction, in randomised order, in the use of seven different inhaler devices. After instruction they were graded (using predetermined criteria) in their inhaler technique. After assessment patients were asked which three inhalers they most preferred and which, if any, they currently used. Technique was best using the breath-actuated inhalers; the Easi-Breathe® and Autohaler®, with 91% seen to have good technique. The pressurized metered dose inhaler (pMDI) fared poorly, in last position with only 79% of patients showing good technique, despite being the most commonly prescribed. The Easi-Breathe® was by far the most popular device with the patients. The Autohaler® came in second position closely followed by the Clickhaler® and Accuhaler®. The majority of patients (55%) currently used the pMDI but the pMDI did not score highly for preference or achieve better grades than the other devices. Only 79% of patients tested could use the pMDI effectively even after expert instruction yet it continues to be commonly prescribed. This has important repercussions for drug delivery and hence disease control. Prescribing a patient's preferred device increases cost but can improve efficiency and therefore be cost effective in the long term. Using an inexpensive device (pMDI) when technique is good and the patient's preferred inhaler device when not is one way to optimise delivery and may even reduce cost.

[http://www.resmedjournal.com/article/S0954-6111\(99\)90767-9/abstract](http://www.resmedjournal.com/article/S0954-6111(99)90767-9/abstract)

109. Modern inhalers: to what degree are we capable of remembering how to use them?

T Lo, A Wong, A Alismail, MH Terry, D Dodge, J Merrill-Henry, P Gold

American Journal of Respiratory and Critical Care Medicine 1 May 2012; **185**(Suppl):A3331
Paper presented at the American Thoracic Society 2012 International Conference, San Francisco, California, USA, 18-23 May 2012.

110. Using bronchodilator aerosols

JC McElnay

Pharmaceutical Journal 7 Apr 1984; **232**:425-426

By teaching patients how to use bronchodilator products correctly pharmacists can be of great help in improving the therapeutic outcome of the treatment. In a survey carried out among pharmacists, 98% of respondents indicated that they would be prepared to become involved in this area of patient education.

111. Audiovisual demonstration for patient counselling in the use of pressurised aerosol bronchodilator inhalers

JC McElnay, MG Scott, AP Armstrong, CF Stanford

Journal of Clinical Pharmacy and Therapeutics Apr 1989; **14**(2):135-144

The use of video as a method of instructing subjects on correct inhaler technique was compared with the written and personal instruction of 150 volunteer subjects with no previous experience of such a device. Video was found to be as effective as personal tuition by a pharmacist and significantly (P less than 0.05) superior to the manufacturer's package insert in teaching correct inhaler technique. The technique was assessed by a panel of 5 investigators in each case and was found to deteriorate over a 2-week period regardless of the instruction method. The video, which was prepared 'in-house', was then assessed in both the hospital out-patient and the general practice pharmacy settings. Asthmatic patients found the video useful at identifying mistakes they were making and felt that this approach to their education should be more widely available.

<http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2710.1989.tb00232.x/abstract>

112. Inhaler technique: does poor technique mean more admissions?

N Main, S Zaidi, J Williams, T Monaghan, H Burhan

American Journal of Respiratory and Critical Care Medicine 1 May 2012; **185**(Suppl):A3333
Paper presented at the American Thoracic Society 2012 International Conference, San Francisco, California, USA, 18-23 May 2012.

http://ajrccm.atsjournals.org/cgi/content/meeting_abstract/185/1_MeetingAbstracts/A3333?sid=8cd6fb18-7fea-4827-a3ff-575a71d53319

113. Misuse of metered dose inhalers by house staff members

JC Mas, DJ Resnick, DE Firschein, BR Feldman, WJ Davis

American Journal of Diseases of Children Jul 1992; **146**(7):783-784

A study by both questionnaire and practical sessions which looked at the ability of 53 house physicians to counsel on how to use metered dose inhalers. The technique was divided into 7 parts. Only 5 (10%) had 'perfect' technique. 8 (15%) doctors held the inhaler upside down, and forgot to remove the cap! The authors conclude that doctors should be taught inhaler technique when they are students and that this should be re-emphasised during their medical postgraduate training. The role of pharmacists is not discussed.

<http://archpedi.ama-assn.org/cgi/content/summary/146/7/783-a>

114. Inhaler mishandling remains common in real life and is associated with reduced disease control

AS Melani, M Bonavia, V Cilenti, C Cinti, M Lodi, P Martucci, M Serra, N Scichilone, P Sestini, M Aliani, M Neri (Gruppo Educazionale Associazione Italiana Pneumologi Ospedalieri (AIPO)) *Respiratory Medicine* Jun 2011; **105**(6):930-938

Proper inhaler technique is crucial for effective management of asthma and COPD. This multicentre, cross-sectional, observational study investigated the prevalence of inhaler mishandling in a large population of experienced patients referred to chest clinics; to analyse the variables associated with misuse and the relationship between inhaler handling and health-care resources use and disease control. We enrolled 1664 adult subjects (mean age 62 years) affected mostly by COPD (52%) and asthma (42%). 843 and 1113 patients respectively were using MDIs and DPIs at home; of the latter, 82, 467, 505 and 361 respectively used Aerolizer®, Diskus®, HandiHaler® and Turbuhaler®. We have a total of 2288 records of inhaler technique. Critical mistakes were widely distributed among users of all the inhalers, ranging from 12% for MDIs, 35% for Diskus® and HandiHaler® and 44% for Turbuhaler®. Independently of the inhaler, we found the strongest association between inhaler misuse and older age ($p = 0.008$), lower schooling ($p = 0.001$) and lack of instruction received for inhaler technique by health caregivers (p less than 0.001). Inhaler misuse was associated with increased risk of hospitalisation ($p = 0.001$), emergency room visits (p less than 0.001), courses of oral steroids (p less than 0.001) and antimicrobials (p less than 0.001), and poor disease control evaluated as an ACT score for the asthmatics (p less than 0.0001) and the whole population (p less than 0.0001). We conclude that inhaler mishandling continues to be common in experienced outpatients referred to chest clinics and is associated with increased unscheduled health-care resource use and poor clinical control. Instruction by health caregivers is the only modifiable factor useful for reducing inhaler mishandling.

[http://www.resmedjournal.com/article/S0954-6111\(11\)00009-6/abstract](http://www.resmedjournal.com/article/S0954-6111(11)00009-6/abstract)

115. Inhaler mishandling is very common in patients with chronic airflow obstruction and long-term home nebuliser use

AS Melani, PA Canessa, I Coloretti, G DeAngelis, R DeTullio, M Del Donno, R Giacobbe, I Scarlato, A Serafini, N Barbato, A Vaghi, P Sestini *Respiratory Medicine* May 2012; **106**(5):668-676

This multicentre, cross-sectional, observational study was performed in a large population of outpatients with chronic airflow obstruction (CAO), regularly using home aerosol therapy and referring to chest clinics. The aims of the study were to compare the characteristics of the group of subjects with CAO who were using home nebulisers but also experienced with inhalers vs those only using inhalers and to investigate whether the first group of subjects was particularly prone to inhaler misuse. Information was gained evaluating the responses to a standardised questionnaire on home aerosol therapy and the observations of inhaler technique. We enrolled 1527 patients (58% male; mean +/- SE; aged 61.1 +/- 0.4 years; FEV1% pred 69.9 +/- 0.6; 51% and 44% respectively suffering from COPD and asthma) who were only inhaler users (OIU group) and 137 (85% male; aged 67.7 +/- 1.3 years; FEV1% pred 62.3 +/- 2.9; 60% and 23% respectively suffering from COPD and asthma) who were using both nebulisers and inhalers (NIU group). Nebuliser users were older, had more severe obstruction, related symptoms and health care resources utilisation. Nebuliser users performed more critical inhaler errors than those of the OIU group (49% vs 36%; $p = 0.009$).

We conclude that our patients with CAO and regular nebuliser treatment had advanced age, severe respiratory conditions and common inhaler misuse.

<http://dx.doi.org/10.1016/j.rmed.2011.11.016>

116. Inhalation technique and variables associated with misuse of conventional metered-dose inhalers and newer dry powder inhalers in experienced adults

AS Melani, D Zanchetta, N Barbato, P Sestini, C Cinti, PA Canessa, S Aiolfi, M Neri (Associazione Italiana Pneumologi Ospedalieri Educational Group)

Annals of Allergy, Asthma and Immunology Nov 2004;**93**(5):439-446

Background: Pressurised metered-dose inhalers (pMDIs) are often poorly used, but little information is available concerning use of the newer dry powder inhalers (DPIs).

Objective: To estimate the inhalation technique and variables associated with the misuse of pMDIs and newer DPIs in clinical practice.

Methods: A multicentre, observational survey was used to evaluate the inhalation technique in 1404 experienced outpatients aged 15 to 88 years affected mostly by asthma (47%) and chronic obstructive pulmonary disease (39%). A total of 1056 patients were using pMDIs, 190 in conjunction with a large volume spacer (LVS); regarding DPIs, 230 patients were using the Aerolizer Inhaler, 524 were using the Turbuhaler and 475 were using the Diskus. In each centre, a trained observer recorded patients' inhalation techniques for each inhaler used against a standardised step-by-step checklist.

Results: 24% and 3% of patients used pMDIs poorly, alone or with an add-on LVS, respectively. Failure to correctly perform essential steps for reliable lung delivery with the Aerolizer Inhaler, Turbuhaler and Diskus was found in 17%, 23% and 24% of patients, respectively. There was no difference in most variables correlated with poor inhalation between patients using pMDIs and those using DPIs.

Conclusions: The use of DPIs is associated with a similar percentage of inadequate inhalation technique as the use of pMDIs in clinical practice. The addition of an LVS to a pMDI and education from health care personnel, rather than simply changing inhalers, represent the best strategies for minimising poor inhalation technique.

<http://www.sciencedirect.com/science/article/pii/S108112061061410X>

117. Knowledge of actions of inhaled corticosteroids in patients who did not persist drug treatment early

TT Menckeberg, JG Hugtenburg, JW Lammers, JAM Raaijmakers, ML Bouvy

International Journal of Clinical Pharmacy Apr 2012;**34**(2):277-281

Objective: To evaluate, among new users of inhaled corticosteroids who did not persist with treatment, knowledge of the actions of inhaled corticosteroids, and whether the patients were instructed on the use of their inhaler.

Setting: Fifteen community pharmacies in the Netherlands.

Methods: Patients were interviewed by telephone. Their general practitioners provided diagnostic information and automated dispensing records were retrieved.

Main Outcome Measures: Patients' knowledge about the actions of inhaled corticosteroids.

Results: 230 (80.1%) of 287 patients were willing to participate. The majority (79.1%) of the 230 patients were not aware of the anti-inflammatory actions of inhaled corticosteroids. Most patients had been instructed on the use of their inhaler, predominantly by their physician (53%) or at the pharmacy (35.2%).

Conclusions: Although most patients reported inhaler instruction by at least one health care provider, the majority were unaware of the actions of inhaled

corticosteroids. Physicians and pharmacists should reconsider the instructions they provide, especially to patients who should use inhaled corticosteroids continuously.
<http://www.springerlink.com/content/q3p7873j42222131/fulltext.pdf>

118. Evaluation of pharmacists' practice in patient education when dispensing a metered-dose inhaler

TR Mickle, TH Self, GE Farr, DT Bess, SJ Tsiu, FL Caldwell
Annals of Pharmacotherapy Oct 1990;**24**(10):927-930

Improper inhalation technique with beta-agonist metered-dose inhalers (MDIs) decreases efficacy of the bronchodilator. The success of demonstrating the correct technique and the pharmacist's role in patient education has been reported. To obtain information regarding the routine patient education practice of pharmacists when dispensing a beta-agonist MDI (salbutamol), the following study was performed. 52 prescriptions for a salbutamol MDI were presented to 52 randomly chosen community pharmacists in three Tennessee (USA) cities. 26 independent and 26 chain pharmacies were evaluated. Pharmacists' practice with regard to patient education, instruction and demonstration of the correct usage of the MDI was observed and recorded. Overall, 13% of the pharmacists initially offered to educate the patient-investigator (PI) regarding the correct usage of the MDI without being asked for information. 53% of pharmacists offered information only upon being asked specifically how to use the MDI. Of the pharmacists who offered to educate the PI, 71% discussed less than half of the eight steps correctly. Only 1 of the 52 pharmacists actually demonstrated MDI inhalation technique, and this in response to a request. No pharmacist asked the PI to perform the technique while he/she observed. No pharmacist offered information on delivery enhancement devices. Our results demonstrate that few pharmacists educate patients on the correct usage of an MDI, and that many pharmacists are not aware of the correct technique.

<http://www.theannals.com/content/24/10/927.short>

119. Results of a physician and respiratory therapist collaborative effort to improve long-term metered-dose inhaler technique in a pediatric asthma clinic

BA Minai, JE Martin, RC Cohn
Respiratory Care Jun 2004;**49**(6):600-605

Background: Despite advances in therapy, asthma continues to be the chronic condition most responsible for school absenteeism and paediatric hospitalisations.

This is especially true for inner-city children. We operate an inner-city Pediatric Asthma Compliance and Technique (PACT) clinic in which physicians and respiratory therapists collaborate to improve metered-dose inhaler (MDI) technique and outcomes among asthmatic children.

Objective: To determine the efficacy of our strategy for improving MDI technique and asthma outcomes.

Methods: Children referred to the PACT clinic underwent standardised assessment based on the Expert Panel Guidelines of the National Heart, Lung, and Blood Institute (NHLBI). Clinicians demonstrated and reinforced correct MDI technique at each visit. Using a standardised format we prospectively collected, at the patient's first visit (T1) and most recent visit (T2), data on demographics, MDI-technique scores (MDI steps done correctly; scale of 0-8), pulmonary function and asthma severity (NHLBI classification scale: 1 = mild intermittent to 4 = severe persistent). Statistical analyses were performed using parametric and non-parametric tests.

Results: Of the 60 patients who attended the PACT clinic between 1999 and 2002, 15 were excluded from the study because of incomplete data recording. Mean duration from T1 to T2 was 11.8 +/- 9.5 months. At T1 and T2, respectively, the mean MDI-technique scores were 53% and 81%, the mean overall asthma severity scores were 2.6 and 2.3, and the mean overall pulmonary function severity scores were 2.4 and 2.1. MDI-technique scores significantly improved between T1 and T2 (p less than 0.001). The black patients had the largest improvement in MDI technique (p less than 0.001), but their pulmonary function test results, overall asthma severity, and pulmonary function severity did not improve significantly. The white patients significantly improved both their MDI technique (p = 0.004) and their overall asthma severity scores (p = 0.005).

Conclusions: In our PACT clinic asthmatic children showed sustained improvement in MDI technique, and some of the patients improved in pulmonary function and overall asthma severity score.

<http://www.rcjournal.com/contents/06.04/06.04.0600.pdf>

120. Addressing the problem of noncompliance with inhalers by design: the 'patient-friendly' approach

JP Mitchell

Therapeutic Delivery Oct 2011;**2**(10):1217-1219

The issue of the noncompliant use of oral inhalers by patients has been known about for some time. The Aerosol Drug Management Improvement Team group in Europe has acknowledged that the ability of the patient to use the device properly is critical, as inhaler mishandling, which is part of the noncompliance issue, is associated with reduced control of obstructive lung disease and therefore needs to be treated as a matter of concern by all involved in the chain of medication supply. Training the patient and/or caregiver, as well as the prescribing clinician, in the correct inhaler preparation and use is an essential component in the process towards achieving reliable and repeatable medication delivery. However, it appears that by itself, even repeated instruction is insufficient to achieve improved compliance in the long term, as patients or caregivers tend to forget what they have learned over time.

There has been a gradual realisation that choosing the inhaler that the patient prefers, rather than the one favoured by the clinician, or that is most readily available, should result in better outcomes in terms of long-term correct use in accordance with the instructions in the package insert.

The author concludes that stakeholders involved with the provision of new drug products and associated devices should give serious consideration to the incorporation of low-cost aids that assist the patient or caregiver through the entire process of taking their inhaled medication, from receipt at the dispensing pharmacy to the time when replacement is required.

<http://www.future-science.com/doi/full/10.4155/tde.11.92>

121. Assessment of handling of inhaler devices in real life: an observational study in 3811 patients in primary care

M Molimard, C Raherison, S Lignot, F Depont, A Abouelfath, N Moore

Journal of Aerosol Medicine Sep 2003;**16**(3):249-254

The correct use of inhalation devices is an inclusion criterion for all studies comparing inhaled treatments. In real life, however, patients may make many errors with their usual inhalation device, which may negate the benefits observed in clinical trials.

This study was undertaken to compare inhalation device handling in real life. A total of 3811 patients treated for at least 1 month with an inhalation device (Aerolizer,

Autohaler, Diskus, pressurised metered dose inhaler (pMDI), or Turbuhaler) were included in this observational study performed in primary care in France between 1 Feb and 14 Jul 2002. General practitioners had to assess patient handling of their usual inhaler device with the help of a checklist established for each inhaler model, from the package leaflet. 76% of patients made at least one error with pMDI compared to 49-55% with breath-actuated inhalers. Errors compromising treatment efficacy were made by 11-12% of patients treated with Aerolizer, Autohaler or Diskus compared to 28% and 32% of patients treated with pMDI and Turbuhaler, respectively. Overestimation of good inhalation by GPs was maximal for Turbuhaler (24%), and lowest for Autohaler and pMDI (6%). 90% of GPs felt that participation in the study would improve error detection. These results suggest that there are differences in the handling of inhaler devices in real life in primary care that are not taken into account in controlled studies. There is a need for continued education of prescribers and users in the proper use of these devices to improve treatment efficacy.

<http://online.liebertpub.com/doi/abs/10.1089/089426803769017613>

122. A one-year prospective audit of an asthma education programme in an out-patient setting

E Mulloy, D Donaghy, C Quigley, WT McNicholas
Irish Medical Journal Nov-Dec 1996;**89**(6):226-228

A prospective randomised trial was performed to evaluate the effectiveness of an asthma education programme administered by an asthma nurse specialist in an outpatient setting. 60 asthmatic patients (mean age 28.5 years) were enrolled, 30 to a usual care control group and 30 to an education group. The education group underwent an individual education programme lasting at least one hour. The following variables were measured at baseline, 1 month after the education programme and at 1 year follow-up: asthma knowledge by MCQ (36-point questionnaire), inhaler technique (7-point scale), peak expiratory flow rate (PEFR) and symptomatology by visual analogue score (0 to 10 score). The education group's inhaler technique and MCQ score both improved significantly at 1 month, from 5.4 (0.3) (mean (SEM)) to 6.5 (0.3), p less than 0.001, and from 7.5 (2.4) to 22 (1.8), p less than 0.0001 respectively. Both of these improvements were significantly greater than in the control group, and both were maintained at 1 year follow-up. The symptom score improved over 1 year in the education group, from 5.4 (0.6) to 7.6 (0.5), p less than 0.05, and was unchanged in the control group. There was no change in the PEFR in either group. This study shows clear objective benefits to an outpatient asthma education programme conducted by an asthma nurse specialist.

http://www.imj.ie/Archive/Pages%20from%2002_Papers-7.pdf

123. Asthma self-management skills and the use of asthma education during pregnancy

VE Murphy, PG Gibson, PI Talbot, CG Kessell, VL Clifton
European Respiratory Journal Sep 2005;**26**(3):435-441

During pregnancy, patients with asthma are at risk of poor outcomes, particularly when asthma is poorly controlled. The aim of this study was to determine the level of asthma self-management skills and knowledge among pregnant subjects and describe the implementation of an asthma education programme delivered in an antenatal clinic setting in Australia.

Pregnant subjects with asthma were assessed by an asthma educator at 20 (n=211) and 33 weeks gestation (n=149). Lung function, symptoms, medication use, adherence, knowledge and inhaler technique were assessed. They were asked whether they had a written asthma action plan, or performed peak flow monitoring. Asthma was classified as mild, moderate or severe.

At the first visit with the asthma educator, 40% of females reported nonadherence to inhaled corticosteroids, inhaler technique was assessed as inadequate in 16% and 42% had inadequate medication knowledge. Peak flow monitoring was performed by 3% and 15% had a written action plan. There were significant improvements in all aspects of asthma self-management following education. In females with severe asthma, night symptoms and reliever medication use significantly decreased after education.

In conclusion, during pregnancy, patients with asthma have poor asthma knowledge and skills, and may benefit from self-management education as part of their obstetric care.

<http://erj.ersjournals.com/content/26/3/435.full.pdf+html>

124. Influence of an interactive computer-based inhaler technique tutorial on patient knowledge and inhaler technique

M Navarre, H Patel, CE Johnson, et al.

Annals of Pharmacotherapy Feb 2007;**41**(2):216-221

Patient knowledge of correct inhaler technique is essential in the treatment of pulmonary disease. Computer delivery of educational content may augment existing teaching efforts. The purpose of the study was to determine whether a computer-based tutorial on inhaler technique could improve patients' knowledge and ability to correctly demonstrate inhaler technique. A total of 34 adults with pulmonary disease and experience using inhalers were randomised into the control or intervention groups. The intervention group viewed the tutorial, after which they demonstrated their inhaler technique and completed an Inhaler Technique Knowledge Test. Control group patients, who did not view the tutorial, were also evaluated on their demonstrated inhaler technique and technique knowledge. Additional information obtained included demographics, illness and treatment history, and patients' use of computers. Lastly, all patients who viewed the tutorial completed a brief questionnaire eliciting tutorial feedback. Control group patients were invited to view the tutorial after other data collection was complete. The 2 principal outcomes were the observed inhaler technique score and the inhaler technique knowledge test score. Comparisons between groups were conducted using Student's t-test and chi-squared test, with a p value less than 0.05 considered statistically significant. 18 subjects were enrolled in the computer group; 16 were in the control group. The intervention group demonstrated significantly better inhaler technique, with a mean Observed Inhaler Technique Score of 88.3 +/- 12.3 compared with 67.4 +/- 19.2 for the control group. The intervention group also scored significantly higher on the Inhaler Technique Knowledge Test, with a score of 80.9 +/- 17.0 vs 67.4 +/- 11.8 for the control group. Overall, the programme appeared acceptable to patients. Patients in the tutorial group demonstrated better inhaler technique and scored higher on the Inhaler Technique Knowledge Test compared with those in a control group. This tutorial may be a useful educational tool to enhance patient education regarding inhaler technique.

<http://www.theannals.com/content/41/2/216.abstract>

125. Telephonic monitoring and optimization of inhaler technique

P Nelson, HN Young, MJ Knobloch, SA Griesbach
Telemedicine Journal and e-Health Nov 2011; **17**(9):734-740

Introduction: Improper inhaler technique is a common problem affecting asthma control and healthcare costs. Telephonic asthma management can increase access to care while reducing costs and hospitalisations. However, no reliable method has been established for telephonically evaluating and correcting inhaler technique.

Objective: The purpose of this study was to pilot test a method for assessing and correcting patient inhaler technique via telephone.

Methods: Participants (n = 30) were adults with asthma using metered-dose inhalers (MDIs) and Diskus inhalers. A pharmacist was located in one room and communicated via telephone with a participant in another room. The pharmacist telephonically assessed and taught inhaler technique. Participants were video-recorded, and videos were later examined by a second pharmacist to visually evaluate inhaler technique. Participants were assigned pre- and post-education inhaler technique scores for the telephonic and video assessments. Scores were based on summated scales for MDI (0-9) and Diskus (0-11) inhalers. Paired sample t-tests were used to compare telephone and video assessments.

Results: Findings indicated a significant difference between the telephone and video assessments of MDI technique (p less than 0.05); however, no difference was found for the Diskus inhaler. Comparing pre- and post-education inhaler technique for MDI and Diskus, mean scores significantly improved from 5.7 to 7.8 (p less than 0.05) and from 8.5 to 10.4 (p less than 0.05), respectively.

Conclusions: The telephonic method was able to improve and detect some deficiencies in patients' inhaler technique. However, modifications and further investigation will more clearly determine the role and value of such a telephonic intervention.

<http://online.liebertpub.com/doi/abs/10.1089/tmj.2011.0047>

126. Assessment of patient acceptance and inhalation technique of a pressurized aerosol inhaler and two breath-actuated devices

CJ Nimmo, DN Chen, SM Martinusen, TL Ustad, DN Ostrow
Annals of Pharmacotherapy Jul-Aug 1993; **27**(7/8):922-927

Objective: To assess inhalation technique in patients after written instruction alone, written and verbal instruction, and clinical use of two new inhalation devices.

Design: Randomised, crossover evaluation of the salbutamol Diskhaler and the terbutaline Turbuhaler.

Setting: Canadian tertiary-care hospital.

Patients: 20 hospitalised adults with asthma or chronic obstructive pulmonary disease currently using a salbutamol metered-dose inhaler (MDI). 19 patients received Diskhaler, 16 received Turbuhaler, 15 received both inhalers and 10 patients used both inhalers for 3 days each.

Interventions: Patients were randomized to receive either Diskhaler or Turbuhaler for 3 days. Inhaler technique was assessed after written instruction, written plus verbal instruction, at the first scheduled dose after instruction and after 3 days of clinical use. Patients remaining in the hospital after 3 days crossed over to the other study inhaler and the same protocol was followed.

Main Outcome Measures: Patient inhalation technique was assessed and compared for the MDI, Diskhaler and Turbuhaler.

Results: Assessment of MDI technique revealed that 35% of patients used their MDI correctly on the first puff, and 42% used it correctly on the second puff. Following written instruction alone, correct technique was demonstrated by 32% of patients

with Diskhaler and 6% with Turbuhaler. Technique significantly improved following verbal instruction, although 40% of the patients required up to 3 attempts to demonstrate correct technique on at least one of the study inhalers. After 3 days of clinical use, correct technique was demonstrated in only 54% of the Diskhaler and 64% of the Turbuhaler assessments. Performance at this assessment was, however, significantly better on the Turbuhaler than on the MDI ($p = 0.01$). Performance on the Diskhaler was not significantly different from the performance on the other inhalers.

Conclusions: Written instruction alone is inadequate in teaching correct inhalation technique. Verbal instruction and technique assessment are essential for patients to achieve proper technique. Patients may perform better on the Turbuhaler than on other inhalation devices.

<http://www.theannals.com/content/27/7/922.abstract>

127. An evaluation program that improves the psychomotor skills needed for metaproterenol use

KA O'Bey, LK Jim, JP Gee, et al.

Drug Intelligence and Clinical Pharmacy Dec 1982;**16**(12):945-948

Pharmacists provided a standardised education programme for 3 clinic visits for asthma patients and those with chronic obstructive pulmonary disease. Proper use of the inhaler was assessed by evaluating the patient's psychomotor performance for each visit before and after instruction. Of 19 patients involved in the study 18 demonstrated a mean improvement of 33.5% from pre-instruction to post-instruction evaluation at the first visit. Both pre-instruction and post-instruction scores demonstrated an upward trend for all 3 visits, the post-instruction scores always being higher than the pre-instruction ones.

<http://www.theannals.com/content/16/12/945.abstract>

128. Metered dose inhaler technique of nurses and trained medication aides

MB O'Connell

Consultant Pharmacist Feb 1993;**8**:145-149

A total of 50 community nurses, nurses from a hospital geriatric unit, and nurses and trained medication aides from nursing homes were assessed for their ability to instruct patients in the use of metered dose inhalers, against a check list (reproduced in the article) of points for recitation and demonstration. Results were generally poor; the 3 subjects who used a MDI themselves were better at demonstrating it but not at explaining its use. Only 46% had ever received formal training in MDI technique. (13 refs.)

129. Short- and long-term retention of a nursing home education program on metered-dose inhaler technique

MB O'Connell, JM Hewitt, TE Lackner, JD Pastor, MT Wong, AL Bishop

Annals of Pharmacotherapy Jul-Aug 1992;**26**(7-8):980-984

Objective: To evaluate an education programme on metered-dose inhaler (MDI) technique designed for nurses and trained medication aides (TMAs).

Design: The education programme included a handout, a lecture incorporating a videotape on correct inhaler and device technique, and hands-on experience with placebo inhalers. The participants' ability to verbalise and demonstrate correct MDI

technique was assessed by the same two-person teams before, immediately after and 2 months after the programme.

Setting: Five nursing homes.

Participants: 56 nurses and TMAs practising in nursing homes.

Main Outcome Measures: Learning and retention.

Results: The participants' mean (+/- SD) verbal and demonstration scores increased immediately after the programme by 68 +/- 18 points for verbalisation and 47 +/- 16 points for demonstration. The participants were always better at demonstrating than verbalising MDI technique. The participants' baseline verbal and demonstration scores correlated with the amount learned. Learning was influenced by the individual nursing home (verbal and demonstration) and personal use (demonstration only), but not by academic degree, previous training, past instruction of a patient or current care of a patient who was receiving inhaler therapy. After 2 months, the scores were lower than immediately after the programme test by 0-92 points for verbalisation and 10-80 points for demonstration; however, the mean scores were still significantly greater (p less than 0.05) than the baseline scores. Retention of knowledge on the correct technique was greater for the demonstration component. Retention was influenced only by the nursing home in which the participant worked, and not any of the other variables.

Conclusions: Our structured education programme significantly improved inhaler technique; however, to maintain retention of the material, the programme should be repeated frequently.

<http://www.theannals.com/content/26/7/980.abstract>

130. Patient error in use of bronchodilator metered aerosols

J Orehek, P Gayrard, C Grimaud, J Charpin

British Medical Journal 10 Jan 1976;**I**(6001):76

Study in France in 20 asthmatic patients (12 men, 8 women; mean age 44 years). All were being treated with bronchodilator sprays and knew how to operate them. On the first day the patients were told to inhale two puffs of a bronchodilator spray in their customary way. On the second day two puffs of the same bronchodilator spray were administered by the physician. The bronchodilation achieved by the two procedures was similar in only 5 patients. In the 15 others it was greater when the aerosol was given by the physician. Observation showed that only the 5 patients in whom bronchodilation was similar by both methods correctly inhaled (that is, at the beginning of a deep inspiration) on self-administration. The other 15 patients failed either to inspire deeply or hold their breath afterwards, or both, or poorly coordinated the puff and the inspiration. The authors conclude that their findings show that the bronchodilation achieved by self-administration may be less than the maximum possible and that, in general, more careful inhalation yielded significantly better results. They advise that, since asthmatic patients seem either not to read or to be unable to follow the instructions supplied with bronchodilator metered aerosols, chest physicians should show their patients how to use the canister correctly and emphasise the importance of the proper method.

http://www.bmj.com/highwire/filestream/209054/field_highwire_article_pdf/0/76.1.full.pdf

131. Asthma advice giving by community pharmacists

LM Osman, CM Bond, J Mackenzie, S Williams

International Journal of Pharmacy Practice Mar 1999;**7**(1):12-17

A postal questionnaire was sent to 180 community pharmacists to investigate the asthma advice they provided. 125 questionnaires were returned giving a response

rate of 69%. Respondents had dispensed a median of 70 asthma medications per week to approximately 40 customers. Most had given advice no more than twice a week. In the previous month half had checked inhaler technique and 75% had provided an inhaler as an emergency supply. Areas in which patients sought advice included problems with inhalers, concerns about side effects and the use of peak flow meters. Responses were discussed in a focus group, where pharmacists expressed concerns about their training in advice giving for inhaler skills. Pharmacists who had received training were significantly more likely to feel confident in providing advice. 61% of pharmacists wanted more training in advice giving skills.

<http://onlinelibrary.wiley.com/doi/10.1111/j.2042-7174.1999.tb00944.x/abstract>

132. Evaluation of education provided by a pharmacist to hospitalized patients who use metered-dose inhalers

G Owens-Harrison, R Grimm, D Gray, OR Harrison

Hospital Pharmacy Jun 1996;**31**(6):677-681

This study evaluated the effectiveness of a pharmacist education programme that teaches hospitalised patients the proper technique for metered-dose inhaler (MDI) usage. During initial (baseline) evaluation, when a pharmacist observed the ability of 87 patients to perform 8 sequential steps for proper MDI usage, 74 (85%) of the patients demonstrated incorrect technique. Those patients determined to have incorrect technique were randomised into one of two groups, an educational intervention group and a nonintervention group. Of the 37 patients placed into the educational group, 25 (68%) patients performed all 8 steps correctly after one educational session with the hospital pharmacist. This was a significant improvement (p less than 0.05) over the baseline finding. The group with no intervention from the hospital pharmacist was evaluated on Day 3 of hospitalisation to determine the amount of education provided by other health care personnel, namely, the respiratory therapist, the medical resident and/or nurses. Only 3 patients (2.7%) received education during the first 2 days of hospitalisation. This study revealed a need for the education of hospitalised patients in the proper use of MDIs. Furthermore, it showed that hospital pharmacists can provide education that demonstrates a measurable difference in patient outcome.

133. Inhaler technique maintenance: gaining an understanding from the patient's perspective

L Ovchinikova, L Smith, S Bosnic-Anticevich

Journal of Asthma Aug 2011;**48**(6):616-624

Background: The aim of this study was to determine the patient-, education- and device-related factors that predict inhaler technique maintenance.

Methods: 31 community pharmacists in Australia were trained to deliver inhaler technique education to people with asthma. Pharmacists evaluated (based on published checklists), and where appropriate, delivered inhaler technique education to patients (participants) in the community pharmacy at baseline (Visit 1) and 1 month later (Visit 2). Data were collected on participant demographics, asthma history, current asthma control, history of inhaler technique education, and a range of psychosocial aspects of disease management (including adherence to medication, motivation for correct technique, beliefs regarding the importance of maintaining correct technique and necessity and concern beliefs regarding preventer therapy). Stepwise backward logistic regression was used to identify the predictors of inhaler technique maintenance at 1 month.

Results: In total 145 and 127 participants completed Visits 1 and 2, respectively. At baseline, 17% of patients (n = 24) demonstrated correct technique (score 11/11) which increased to 100% (n = 139) after remedial education by pharmacists. At follow-up, 61% (n = 77) of patients demonstrated correct technique. The predictors of inhaler technique maintenance based on the logistic regression model (X² (3, N = 125) = 16.22, p = 0.001) were use of a dry powder inhaler over a pressurised metered-dose inhaler (OR 2.6), having better asthma control at baseline (OR 2.3) and being more motivated to practice correct inhaler technique (OR 1.2).

Conclusions: Contrary to what is typically recommended in previous research, correct inhaler technique maintenance may involve more than repetition of instructions.

This study found that past technique education factors had no bearing on technique maintenance, whereas patient psychosocial factors (motivation) did.

<http://informahealthcare.com/doi/abs/10.3109/02770903.2011.580032>

134. Inhaler devices for asthma: a call for action in a neglected field

A Papi, J Haughney, JC Virchow, N Roche, S. Palkonen, D Price

European Respiratory Journal May 2011;**37**(5):982-985

An international panel of healthcare providers (HCPs), academics and a patient representative was convened under the auspices of the International Primary Care Respiratory Group (IPCRG) to discuss and challenge the science behind inhaler therapy, and to propose practical solutions to real-life problems related to inhaler choice and mishandling. The focus was on the problems confronting clinicians in prescribing a suitable inhaler for each individual and those confronting patients in using their inhalers.

Concludes that 'the success of the Finnish Asthma Programme demonstrates that a comprehensive approach to management can improve asthma outcomes. Our knowledge of pharmacological interventions in well-defined patient populations is substantial. The need to translate this knowledge into improved care of individual patients in real-life settings by individual clinicians is rightly attracting greater academic attention. Knowledge gaps in the design and performance of inhalers, the practice of prescribing inhalers, patient preferences, and issues around inhaler technique, all of which are fundamental and critical aspects of asthma management, remain substantial and must be addressed.' (33 refs.)

<http://erj.ersjournals.com/content/37/5/982.full.pdf+html>

135. Use of pressurised aerosols by asthmatic patients

IC Paterson, GK Crompton

British Medical Journal 10 Jan 1976;**I**(6001):76-77

A trained respiratory technician assessed 321 asthmatic patients (195 females and 126 males) attending an asthma clinic in Scotland in the use of their inhalers. All the patients were asked to use their inhaler under observation and their technique was classified as: (a) efficient; (b) doubtfully efficient; and (c) inefficient. The results showed that 45 (14%) patients were unable to use their inhalers satisfactorily. Of this total 26 (8.1%) were classified as inefficient and 19 (5.9%) as doubtfully efficient inhaler users. When the 45 patients who were unable to inhale correctly from a pressurised canister were asked to use the Spinhaler, 43 (95.5%) had no difficulty in using this device. The authors conclude that, even after initial tuition, some patients cannot use an inhaler correctly, and regular checks of inhalation technique are therefore necessary, and they have now adopted the practice of checking every patient's technique at every visit to the asthma clinic. This is done by the respiratory technician at the time ventilatory function tests are recorded, since it

is now considered as important to check inhalation technique as it is to measure ventilatory function. They also note that these results confirm their clinical impression that patients have little difficulty in using a Spinhaler, whereas many have problems with the pressurised canister.

http://www.bmj.com/highwire/filestream/209092/field_highwire_article_pdf/0/76.2.full.pdf

136. Errors in inhalation technique and efficiency in inhaler use in asthmatic children

S Pedersen, L Frost, T Arnfred

Allergy Feb 1986;**41**(2):118-124

256 asthmatic children receiving regular inhalation therapy demonstrated how they used their inhalers. Pulmonary function measurements (PFM) were made before and after the demonstrations, and errors in technique were recorded. 242 children had reversible airway obstruction on the day of study. In only 109 (45 %) did the inhalation technique result in an increase in FEV₁ of 15% or more (efficient technique). An efficient inhalation technique was found in 46% of children who demonstrated a pressurised aerosol, 59% who demonstrated a tube spacer aerosol and 46% who demonstrated a Rotahaler, and the frequency of efficient technique varied from 17 % to 84% between six different groups of instructors. 87% of children controlled and 25% not controlled with PFM at the time of prescription had an efficient technique. Children under 6 years had a more inefficient and a more faulty technique than older children, but otherwise age did influence the result. Neither was time since instruction of any importance for efficiency or number of errors. The errors recorded that seem to influence efficiency most were: coordination problems, rapid inspirations, ceasing to inspire when the aerosol was fired, and inhalation through the nose. The results emphasise the paramount importance of clear instructions and control of inhalation technique at the time the treatment is prescribed.

<http://onlinelibrary.wiley.com/doi/10.1111/j.1398-9995.1986.tb00287.x/abstract>

137. Understanding and use of inhaler medication by asthmatics in specialty care in Trinidad: a study following development of Caribbean guidelines for asthma management and prevention

LM Pinto Pereira, Y Clement, CK Da Silva, D McIntosh, DT Simeon

Chest Jun 2002;**121**(6):1833-1840

Following the development of the Caribbean Guidelines for Asthma Care, the authors examined the utilisation of inhaled medications in asthmatic patients in Trinidad, West Indies. A consecutive sample of physician-diagnosed asthmatic patients who attended a chest clinic between Jul 1998 and Aug 2000 and who were older than 7 years (n = 402) was interviewed about compliance with, understanding of, and use of inhaler medication. The inhaler technique of these patients was directly observed. Inhaled steroid therapy was prescribed in 83% of patients but were prescribed the least in elderly patients (63%) and children (62%). Salbutamol was prescribed in 98% of patients, and ipratropium and sodium cromoglycate were selectively prescribed in elderly men and children, respectively. Only 33% of patients used the inhaler correctly, and children and the elderly were the least efficient in its use. The use of a spacer device was advised in 19% of patients, including only 6% of the elderly patients. Explanations for different inhaler therapies were given to 62% of patients, and 53% of patients could describe these reasons. The reported 40% noncompliance rate among patients in the sample was primarily a result of long waiting periods at the pharmacy (58%) and the personal cost incurred on purchasing

the medication (52%). Concludes that educating patients, with a focus on children and the elderly, in inhaler techniques and reinforcing understanding of asthma medications can improve asthma management in Trinidad. Asthma caregivers in the Caribbean should ensure the appropriate dissemination of the guidelines and should outline strategies for their implementation. (36 refs.)

<http://chestjournal.chestpubs.org/content/121/6/1833.full.pdf+html>

138. Medical personnel and patient skill in the use of metered dose inhalers: a multicentric study

V Plaza, J Sanchis (CESEA Group)

Respiration May-Jun 1998;**65**(3):195-198

The objective was to evaluate the correctness of the inhalation technique in a nationwide sample of patients and medical personnel in Spain, in order to define targeted educational goals. A total of 1640 volunteers (746 patients, 466 nurses and 428 physicians) were evaluated. Only 9% of patients, 15% of nurses and 28% of physicians showed a correct inhalation technique. Physicians performed significantly better (mean score 77 +/- 23) than nurses (71 +/- 22) and patients (62 +/- 26). Scores in general practitioners and paediatricians were significantly lower than those of chest physicians and allergists. In conclusion, proper use of metered dose inhalers (MDI) in patients and medical personnel is still faulty. Despite physicians' awareness of the importance of correct inhalation technique in the use of metered dose inhalers, this study shows severe deficiencies, showing the need for substantial changes in educational efforts, and particularly addressed to general practitioners.

<http://content.karger.com/ProdukteDB/produkte.asp?doi=10.1159/000029259>

139. Physicians' knowledge of inhaler devices and inhalation techniques remains poor in Spain

V Plaza, J Sanchis, P Roura, J Molina, M Calle, S Quirce, JL Viejo, F Caballero, C Murio

Journal of Aerosol Medicine and Pulmonary Drug Delivery Feb 2012;**25**(1):16-22

Background: Studies in many countries in the 1990s revealed deficiencies in physicians' knowledge about inhalation therapy. In an attempt to remedy this situation, Spanish scientific societies implemented a variety of educational strategies. The objective of the present study was to assess changes in attitudes and knowledge about inhalers and inhalation techniques in a sizable sample of physicians.

Methods: An 11-question multiple choice test was developed and administered throughout Spain to practicing physicians from specialties that frequently prescribe inhaler devices. The survey collected demographic characteristics (four items), preferences (two items), and issues related to knowledge (three items) and education (two items) about devices and inhalation techniques. Completion of the questionnaire was voluntary, individual and anonymous.

Results: A total of 1514 respondents completed the questionnaire. Dry powder inhalers (DPI) were preferred by 61.2% physicians, but only 46.1% identified 'inhale deeply and forcefully' as the most significant step in the inhalation manoeuvre using these devices. Only 27.7% stated that they always checked the patient's inhalation technique when prescribing a new inhaler. A composite variable, general inhaled therapy knowledge, which pooled the correct answers related to knowledge, revealed that only 14.2% physicians had an adequate knowledge of inhaled therapy. Multivariate analysis showed that this knowledge was lowest among internal medicine and primary care physicians.

Conclusions: Prescribers' knowledge of inhalers and inhalation techniques remains poor in Spain. The causes should be identified in further research to allow effective

educational strategies to be developed. Specific educational policies should be addressed to general practitioners.

<http://online.liebertpub.com/doi/abs/10.1089/jamp.2011.0895>

140. Impact of an asthma education programme on patients' knowledge, inhaler technique and compliance to treatment

L Prabhakaran, G Lim, J Abisheganaden, CBE Chee, YM Choo

Singapore Medical Journal 2006;**47**(3):225-231

Introduction: We conducted a study to assess the impact of an asthma education programme (AEP) on knowledge of asthma and medication, compliance to treatment and inhaler technique, emergency department visits and hospital re-admissions.

Methods: Patients hospitalised for asthma exacerbation were administered a questionnaire to test their baseline knowledge and beliefs on asthma, its medications and their compliance to treatment. Their inhaler technique was assessed. They then underwent an AEP consisting of two individualised education sessions. Re-testing was performed after 3 months. Per protocol approach and McNemar's test was used to analyse the statistical significance of the change in the pre- and post-AEP test scores. Hospital administrative data were used to determine the number of ED visits and hospital admissions pre- and post-AEP.

Results: Among the 67 patients who completed the two-phase AEP, there was significant improvement in some knowledge aspects (ability to identify rescue medication ($p = 0.031$), that different stimuli can trigger asthma symptoms ($p = 0.016$), that a peak flow meter is used for monitoring asthma ($p = 0.004$), that asthma symptoms are caused by airway swelling/narrowing (p less than 0.001), that steroid inhalers are to be used daily as preventive therapy (p less than 0.001), in self-reported inhaler compliance (number of puffs per administration (p less than 0.001) and per day (p less than 0.001)) and in inhaler technique (p -value is 0.001). There was also significant reduction in emergency department attendances (p less than 0.001) and hospital admissions (p less than 0.001) among all 97 subjects over a 1-year period.

Conclusion: This study demonstrated the effectiveness of an AEP in patients hospitalised for asthma exacerbation.

http://www.ttsh.com.sg/uploadedFiles/TTSH/Medical_Professionals/Nursing_TTSH/Nurse_Clinicians/Asthma_1.pdf

141. Misuse of respiratory inhalers in hospitalized patients with asthma or COPD

VG Press, VM Arora, LM Shah, SL Lewis, K Ivy, et al.

Journal of General Internal Medicine Jun 2011;**26**(6):635-642

Background: Patients are asked to assume greater responsibility for care, including use of medications, during transitions from hospital to home. Unfortunately, medications dispensed via respiratory inhalers to patients with asthma or chronic obstructive pulmonary disease (COPD) can be difficult to use.

Objectives: To examine rates of inhaler misuse and to determine if patients with asthma or COPD differed in their ability to learn how to use inhalers correctly.

Design: A cross-sectional and pre/post intervention study at two urban academic hospitals in the USA.

Participants: Hospitalised patients with asthma or COPD.

Intervention: A subset of participants received instruction about the correct use of respiratory inhalers.

Main Measures: Use of metered dose inhaler (MDI) and Diskus devices was assessed using checklists. Misuse and mastery of each device were defined as fewer than 75% and 100% of steps correct, respectively. Insufficient vision was defined as worse than 20/50 in both eyes. Less-than adequate health literacy was defined as a score of below 23/36 on the Short Test of Functional Health Literacy in Adults (S-TOFHLA).

Key Results: 100 participants were enrolled (COPD n = 40; asthma n = 60). Overall, misuse was common (86% MDI, 71% Diskus), and rates of inhaler misuse for participants with COPD versus asthma were similar. Participants with COPD versus asthma were twice as likely to have insufficient vision (43% vs 20%, p = 0.02) and 3-times as likely to have less-than-adequate health literacy (61% vs 19%, p = 0.001). Participants with insufficient vision were more likely to misuse Diskus devices (95% vs 61%, p = 0.004). All participants (100%) were able to achieve mastery for both MDI and Diskus devices.

Conclusions: Inhaler misuse is common, but correctable in hospitalised patients with COPD or asthma. Hospitals should implement a programme to assess and teach appropriate inhaler technique that can overcome barriers to patient self-management, including insufficient vision, during transitions from hospital to home.

<http://www.springerlink.com/content/376up3p6j342861v/>

142. Device type and real-world effectiveness of asthma combination therapy: an observational study

D Price, N Roche, JC Virchow, A Burden, M Ali, A Chisholm, AJ Lee, EV Hillyer, J von Ziegenweidt

Respiratory Medicine Oct 2011; **105**(10):1457-1466

Background: Selection of inhaler device type appears to influence real-world effectiveness of inhaled corticosteroids (ICS), but data are lacking on the role of inhaler device in ICS and long-acting beta2-agonist (LABA) combination therapy for asthma.

Methods: This retrospective matched cohort study compared 1-year asthma outcomes for UK patients initiating fixed-dose combination (FDC) fluticasone-salmeterol delivered by pressurised metered-dose inhaler (pMDI) versus dry powder inhaler (DPI). Patients with asthma aged 4–80 years receiving a first prescription for FDC fluticasone-salmeterol by pMDI or DPI were matched on baseline demographic and asthma severity measures. Co-primary outcomes were asthma control (a composite measure comprising no recorded hospital attendance for asthma, oral corticosteroids, or antibiotics for lower respiratory infection) and exacerbation rate. Results: Compared with the DPI cohort (n = 1567), patients in the pMDI cohort (n = 1567) had significantly greater odds of achieving asthma control during the outcome year (odds ratio [OR] 1.19; 95% CI, 1.01 to 1.40). Exacerbation rate was lower but not significantly in the pMDI cohort (adjusted rate ratio for pMDI cohort, 0.82; 95% CI, 0.66 to 1.00). The odds of treatment success (defined as no exacerbations and no change in asthma therapy) was significantly greater in the pMDI cohort (OR 1.23; 95% CI, 1.07 to 1.42).

Conclusions: For UK primary care patients, pMDIs appear to achieve better asthma control outcomes than DPIs for delivery of FDC fluticasone-salmeterol. Pragmatic trials are needed to further investigate real-world outcomes with different inhaler devices for combination therapy.

<http://dx.doi.org/10.1016/j.rmed.2011.04.010>

143. Assessment of in-patient inhaler technique - which device?

VH Raine, K Newberry

Hospital Pharmacy Practice Oct 1991;**1**(5):211-215

A study was carried out in 30 adult in-patients with obstructive airway disease. They were asked about the type of inhalation device they currently used and asked to demonstrate their technique using a placebo device. Technique was assessed using a checklist for each device (that for the metered dose aerosol inhaler (MDAI) is reproduced). Each of 8 devices was then demonstrated to and tried by the patient and comments were noted. All 30 of the patients were using the MDAI and 53% had poor technique. 13/30 (43%) preferred it (although 5 of these had poor technique). The Turbohaler appeared to be the most satisfactory alternative: it was easiest to use, second in patient preference and relatively inexpensive. Older patients (particularly those over 66yr) found it increasingly difficult to use the devices, and the authors suggest that such patients should receive priority for counselling. (4 refs.)

144. The effect of structured versus conventional inhaler education in medical housestaff

D Rebeck, B Dzyngel, K Khan, S Kesten, KR Chapman

Journal of Asthma 1996;**33**(6):385-393

Despite the importance of adequate inhaler technique in the care of asthma and chronic obstructive pulmonary disease, physicians have often been shown to have poor knowledge of correct inhaler use. At present, postgraduate teaching programmes appear to leave physicians to acquire inhaler handling skills informally in the context of day-to-day patient care. We undertook the present study to determine if one brief structured educational intervention would be adequate to teach postgraduate physicians inhaler skills that would be retained over long periods of time. We also compared the efficacy of this intervention to traditional education methods. We recruited 52 postgraduate trainees in internal medicine at a large university hospital in Canada; 26 were in the educational intervention group and 26 were in the control group. Physicians in the intervention group were asked to respond to a questionnaire on inhaler use and to demonstrate the correct use of a metered-dose inhaler (MDI), an MDI with a spacing chamber and a multidose dry-powder inhaler. These intervention subjects were then instructed on proper inhaler usage by a qualified nurse educator. Eight months later, testing was repeated in the intervention group and was undertaken in the control group. Questionnaire scores were significantly higher in the intervention group at the 8-month follow-up than at baseline (59% vs 42%; p less than 0.05). Similarly, the scores of the intervention group at follow-up were significantly higher than those of the control group (59% vs 39%; p less than 0.05). There was no significant difference between the baseline scores of the intervention group and those of the control group. The mean demonstration score was significantly higher in the intervention group at follow-up than at baseline (68% vs 39%; p less than 0.001) and was also higher than that of the control group (68% vs 44%; p less than 0.001). There was no significant difference between the scores for all devices between the intervention group before education and the control group. Our data show that one brief teaching session is sufficient to produce a sustained improvement in knowledge and handling of inhalers by postgraduate physicians. The knowledge and skills of the physicians educated in our study were not only better than before they had received instruction, but were better than the knowledge and skills of postgraduate trainees from the same institution who had received no formal training. This latter observation suggests a

failure of traditional unstructured postgraduate training programmes to teach this practical patient care skill.

<http://informahealthcare.com/doi/abs/10.3109/02770909609068183>

145. Pharmacist interventions in asthma

HK Reddel, SZ Bosnic-Anticevich, CL Armour, I Basheti

European Respiratory Journal Sep 2008;**32**(3):812 (letters)

Letter commenting on a paper by Mehuys et al. (*Eur Resp J* Apr 2008;**31**(4):790-799). The writers request information about which intervention components were delivered at each study visit, and the total time taken per visit for intervention and usual care groups. They comment that 'although inhaler technique in this study was not checked when asthma was well controlled, we believe that inhaler technique should be checked in all patients at all visits. Inhaler technique deteriorates within 2-3 months of an educational intervention. Poor inhaler technique may contribute not only to poor asthma control but also, in patients with good asthma control, to a continuing need for high prescribed doses of inhaled corticosteroids. In clinical practice, improvement in incorrect inhaler technique may allow reduction in prescribed doses, with potential reduction in local side effects and cost to the community.' The original authors respond.

<http://erj.ersjournals.com/content/32/3/812.1.full>

146. A comparison of various types of patient instruction in the proper administration of metered inhalers

RJ Roberts, JD Robinson, PL Doering, JJ Dallman, RA Steeves

Drug Intelligence and Clinical Pharmacy Jan 1982;**16**(1):53-59

The administration technique employed by 42 inpatients using metered inhalers were observed. Proper performance of the six steps recommended by the manufacturer provided the guidelines for correct administration. The degree of compliance with proper technique was defined as the number of steps correctly executed by the patient. The mean number of steps correctly performed was 2.9 out of the possible 6 (48.3%). 24 patients were then randomised into one of three groups. Group 1 received the manufacturer's instruction sheet, Group 2 received counselling from a pharmacist, and Group 3 received both the manufacturer's instruction sheet and counselling from a pharmacist. There was a significant improvement in the post-instruction technique in Groups 2 and 3, while Groups 1 failed to demonstrate any significant improvement. Comparisons were then made among the three groups. No significant difference was found between Group 2 and Group 3. However, both Groups 2 and 3 were found to be significantly different (p less than 0.05) from Group 1. This study shows that pharmacist counselling can significantly improve the degree of patient compliance in the administration of metered inhalers.

<http://www.theannals.com/content/16/1/53.abstract>

147. The tuition of aerosol inhaler technique

AJ Rogers

Pharmaceutical Journal 6 Oct 1984;**233**(6298):418

Paper presented in the pharmacy practice research session of the British Pharmaceutical Conference, Southampton, 11-14 Sep 1984.

33 patients who presented prescriptions for inhalers at a community pharmacy over a 3-week period were interviewed and their inhaler technique assessed. 20 of the 33 patients (60%) had been physically shown how to use their inhaler, but only 5 patients (15%) had had their technique assessed since therapy was initiated. Of the

11 patients who had first been prescribed inhalers at a hospital clinic, 10 had been properly instructed in their use. However, of the 22 patients whose initial prescriptions had been issued by a GP, only 10 had received tuition or advice from a pharmacist. Assessment of inhaler technique showed little difference in the scores achieved by patients who had been tutored (mean 7.2 on a 10-point scale) and those who had not (6.76). (12 refs.)

148. Correct use of three powder inhalers: comparison between Diskus, Turbuhaler, and Easyhaler

E Rönmark, R Jögi, A Lindqvist, T Haugen, M Meren, H-M Loit, U Sairanen, A Sandahl, B Lundbäck

Journal of Asthma 2005;**42**(3):173-178

A Phase IV, 4-week, open, randomised multicentre, parallel group trial compared correct use and acceptability of Diskus®, Turbuhaler® and Easyhaler® powder inhalers among 326 inhaler naive asthmatics/symptomatics in Scandinavia. The subjects were asked to read the instruction leaflet before taking one dose at the first visit. The correct use was evaluated when the subject took the dose. After that, the subjects were instructed in correct use. The use of the devices was also videotaped at every visit, and independent referees judged correct use. Acceptability was evaluated by a questionnaire. At the first visit, the proportions of subjects who used the devices correctly were as follows: Easyhaler, 45%; Diskus, 43%; and Turbuhaler, 51%. The corresponding figures at the last visit were 84%, 89% and 81%. The differences at any visit were not statistically significant. Acceptability was greater for Easyhaler and Diskus for 3 of 8 items throughout the study, all pertaining to receiving the powder from the device and control of the inhalation of the powder. Authors note that patient education in the use of devices is important, because only half of the subjects used the devices correctly, and still after 4 weeks 10–20% could not use the devices satisfactorily, regardless of which device.

<http://informahealthcare.com/doi/abs/10.1081/JAS-54629>

149. Predictors of incorrect inhalation technique in patients with asthma or COPD: a study using a validated videotaped scoring method

GN Rootmensen, ARJ van Keimpema, HM Jansen, RJ de Haan

Journal of Aerosol Medicine and Pulmonary Drug Delivery Oct 2010;**23**(5):323-328

Background: Inadequate technique reduces the effects of inhalation medication. Errors in inhalation technique have been reported to range up to 85%. Not only various patients' characteristics but also the device has an effect on correct inhalation technique. The purpose of this study was to determine the effect of patients' characteristics and type of inhaler device on inhalation technique in patient with asthma or chronic obstructive pulmonary disease (COPD).
Methods: A validated scoring method was used that consisted of triple viewing of video-recorded inhalations, using device-specific checklists. The following patient characteristics were investigated: gender, age, education level, diagnosis, treatment by a pulmonary physician, previously received inhalation instruction, exacerbation frequency, knowledge, self-management competence, pulmonary function and use of multiple inhaler devices. Chi-squared statistics were used for univariate associations between potential determinants and correctness of inhalation technique. Relevant determinants were entered into a multivariate logistic regression model. Moreover, inhalation technique errors were examined for six inhaler devices: three prefilled dry

powder inhalers, one single-dose dry powder inhaler, a pressurised metered-dose inhaler (pMDI) and a pMDI with a spacer.

Results: Overall, 40% of the patients made at least one essential mistake in their inhalation technique. Patients who never received inhalation instruction and patients who used more than one inhaler device made significantly more errors (odds ratio both 2.2). Comparison between devices showed that a correct inhalation technique most likely occurred with the use of prefilled dry powder devices.

Conclusions: Incorrect inhalation technique is common among asthma and COPD patients in a pulmonary outpatient clinic. Our study suggests that the use of prefilled dry powder inhalers as well as inhalation instruction increases correct inhalation technique. Simultaneous use of different types of inhalation devices has to be discouraged.

<http://online.liebertpub.com/doi/abs/10.1089/jamp.2009.0785>

150. Reliability in the assessment of videotaped inhalation technique

GN Rootmensen, ARJ van Keimpema, EE Looyen, L van der Schaaf, HM Jansen, RJ de Haan
Journal of Aerosol Medicine Dec 2007;**20**(4):429-433

Inhalation medication is essential in the treatment of asthma and chronic obstructive pulmonary disease (COPD) patients. Incorrect inhalation technique reduces the effects of medication and has been reported to range from 22% to 95% from optimal. The objective of this study was to determine inter- and intra-observer reliability in inhalation technique assessment. For inter-observer reliability three observers scored after three times viewing a total of 49 video recorded inhalation demonstrations using device-specific checklists and mutually agreed scoring rules. Intra-observer reliability was assessed for two observers after 8 months by scoring inhalation demonstrations a second time. Both inter- and intra-observer reliability were expressed by mean percent agreement and mean Kappa scores. All inhaler devices revealed a high mean percent agreement and a substantial or almost perfect Kappa scoring for both inter- and intra-observer reliability. Only one item, 'exhale to residual volume', showed poor intra-observer reliability. Assessment of video recorded inhalation technique using device-specific checklists, triple viewing, and mutual agreed scoring rules is reliable. This method enables blind observation of inhalation technique.

<http://online.liebertpub.com/doi/abs/10.1089/jam.2007.0623>

151. Readability of consumer medication information for intranasal corticosteroid inhalers

SE Roskos, LS Wallace, BD Weiss

American Journal of Health-System Pharmacy 1 Jan 2008;**65**(1):65-68

The readability of consumer medication information (CMI) inserts accompanying intranasal corticosteroid (INCS) inhalers currently prescribed in the United States was studied. INCS inhalers were identified (n = 7) using Epocrates Rx Pro and English- language CMI was obtained from each inhaler's manufacturer. The CMI was evaluated for reading grade level (using Fry's readability formula) and font size, dimensions (length and width), illustrations (diagrams and figures), and directions for use. The mean +/- SD reading grade level of the CMI was 6.9 +/- 0.7 (range, 6-8). The mean +/- SD font size was 9.0 +/- 2.2 (range, 6-12). The mean +/- S.D. CMI page length and width were 31.3 +/- 22.5 cm and 14.0 +/- 12.9 cm, respectively. A device-overview figure was included in 3 of the 7 educational samples. The mean size of illustrations was 7.9 cm² (range, 2.9-25.9 cm²), with a mean +/- S.D. of 7.6 +/- 3.2 (range, 3-11) figures per CMI insert. Directions

followed a logical, step-by-step chronological sequence in every CMI insert. Concludes that most CMI for INCS inhalers is written at a reading level slightly higher than recommended, printed in a font size smaller than recommended, and illustrated inadequately for successful patient education.

<http://www.ajhp.org/content/65/1/65.abstract>

152. Inhaler device, administration technique, and adherence to inhaled corticosteroids in patients with asthma

A Roy, K Battle, L Lurslurchachai, EA Halm, JP Wisnivesky
Primary Care Respiratory Journal Jun 2011; **20**(2):148-154

Aim: To compare inhaled corticosteroid (ICS) inhaler type with user technique and ICS medication adherence among adults with asthma.

Methods: We classified 270 adults (from two hospital-based clinics in the USA) into two groups by ICS device type: metered-dose inhaler (MDI) or dry powder inhaler (DPI). Inhaler technique was assessed using standardised checklists. Medication adherence was evaluated using the Medication Adherence Report Scale (MARS). Differences in inhaler technique and MARS score among patients using MDIs versus DPIs were evaluated.

Results: Univariate analysis showed no difference in technique scores between the groups ($p = 0.46$), but better ICS adherence among DPI users ($p = 0.001$). In multivariable analysis, DPI use remained significantly associated with higher rates of adherence (OR 2.2; 95% CI, 1.2 to 3.8) but not with inhaler technique (-0.2 ; 95% CI, -0.5 to 0.1) after adjusting for potential confounders.

Conclusions: Type of inhaler device appears to be associated with adherence to asthma controller medications. Prospective studies are needed to elucidate further the potential effect of the type of ICS delivery device on asthma self-management.

http://www.thepcrj.org/journ/vol20/20_2_148_154.pdf

153. Someone like me? Inhaler-users' views of the models who demonstrate inhaler technique

I Savage

International Journal of Pharmacy Practice Sep 2002; **10**(Suppl.):R82

Abstract of a pharmacy practice research paper presented at the British Pharmaceutical Conference, Manchester, 23-25 Sep 2002.

Patient information leaflets are mandatory, but highly standardised

A sample of mainly white English-speaking inhaler-users aged 12 to 87 was asked for their views on the white male models used in a widely used patient information leaflet ($n = 48$) and a multimedia touch-screen program ($n = 57$)

Of 75 people expressing an opinion, a third (25) said the choice of model mattered to them, and 13 (17%) thought it might matter to some people

There were differences between the two methods in terms of engaging information; there was an association between interest in the information and global change in inhaler technique

Multimedia enables users to personalise the way information is presented; this could increase acceptability and make information more effective.

<http://onlinelibrary.wiley.com/doi/10.1111/j.2042-7174.2002.tb00689.x/abstract>

154. Providing information on metered dose inhaler technique: is multimedia as effective as print?

I Savage, L Goodyer

Family Practice Oct 2003; **20**(5):552-557

Background: Metered dose inhalers (MDIs) are not easy to use well. Every MDI user receives a manufacturer's patient information leaflet (PIL). However, not everyone is able or willing to read written information. Multimedia offers an alternative method for teaching or reinforcing correct inhaler technique.

Objective: The aim of this study was to compare the effects of brief exposure to the same key information, given by PIL and multimedia touchscreen computer (MTS).

Methods: A single-blind, randomised trial was conducted in 105 fluent English speakers (53% female; 93% White) aged 12-87 years in London general practices. All patients had had at least one repeat prescription for a bronchodilator MDI in the last 6 months. Inhaler technique was videotaped before and after viewing information from a PIL (n = 48) or MTS (n = 57). Key steps were rated blind using a checklist and videotape timings. The main outcome measures were a change in (i) global technique; (ii) co-ordination of inspiration and inhaler actuation; (iii) breathing-in time; and (iv) information acceptability.

Results: Initially, more than one-third of both groups had poor technique. After information, 44% (MTS) and 19% (PIL) were rated as improved. Co-ordination improved significantly after viewing information via MTS, but not after PIL.

Breathing-in time increased significantly in both groups. Half the subjects said they had learned 'something new'. The MTS group were more likely to mention co-ordination and breathing.

Conclusions: Short-term, multimedia is as least as effective as a good leaflet, and may have advantages for steps involving movement. MTS was acceptable to all age groups. The method could be used more widely in primary care.

<http://fampra.oxfordjournals.org/content/20/5/552.abstract>

155. Assessment of hospice nurses' technique in the use of inhalers and nebulizers

LT Scarpaci, MG Tsoukleris, ML McPherson

Journal of Palliative Medicine Jun 2007; **10**(3):665-676

This study assessed hospice nurses' ability to demonstrate proper inhaler device technique and their knowledge of agents used to treat dyspnea. 47 nurses participated. Participants completed a written questionnaire, which gathered demographic data, as well as information regarding previous training with an inhaler device, administration, pharmacokinetics, mechanism of action, patient assessment and nursing technique. Additionally, each nurse demonstrated the use of a metered dose inhaler, spacer, dry powder inhaler and a nebuliser, while being observed by a pharmacist trained in the use of inhalers. A standardised evaluation form was used to ensure consistency between evaluators and subjects. Percentage of steps completed correctly by the study participants ranged from 34.9% with the dry powder inhaler to 67.6% with the metered dose inhaler. Years of experience, presence of hospice certification, personal use of inhaler and nursing comfort level significantly impacted ability to use inhalation devices. This study demonstrated the existence of knowledge gaps regarding patient assessment, pharmacology and pharmacokinetics of inhaled medications, and inhalation device technique among hospice nurses. Formal education of hospice practitioners regarding inhaled medications and inhalation delivery devices is needed.

<http://online.liebertpub.com/doi/abs/10.1089/jpm.2006.0180>

156. Measuring the assessment and counseling provided with the supply of nonprescription asthma reliever medication: a simulated patient study

CR Schneider, AW Everett, E Geelhoed, PA Kendall, RM Clifford

Annals of Pharmacotherapy Sep 2009;**43**(9):1512-1518

Over one-quarter of asthma reliever medications are provided without prescription by community pharmacies in Australia. Evidence that community pharmacies provide these medications with sufficient patient assessment and medication counselling to ensure compliance with the Australian government's Quality Use of Medicines principles is currently lacking. To assess current practice when asthma reliever medication is provided in the community pharmacy setting and to identify factors that correlate with assessment of asthma control, researchers posing as patients visited a sample of Perth metropolitan community pharmacies in May 2007. During the visit, the simulated patient enacted a standardised scenario of someone with moderately controlled asthma who wished to purchase a salbutamol (albuterol) inhaler without prescription. Results of the encounter were recorded immediately after the visit. Regression analysis was performed, with medication use frequency (a marker of asthma control) as the dependent variable. 160 community pharmacies in the Perth metropolitan area were visited in May 2007. Pharmacists and/or pharmacy assistants provided some form of assessment in 84% of the visits. Counselling was provided to the simulated patients in 24% of the visits. Only 4 pharmacy staff members asked whether the simulated patient knew how to use the inhaler. Significant correlation was found between assessment and/or counselling of reliever use frequency and 3 independent variables: visit length (p less than 0.001), number of assessment questions asked (p less than 0.001) and the simulated patient who conducted the visit (p less than 0.02). Concludes that both patient assessment and medication counselling were suboptimal compared with recommended practice when nonprescription asthma reliever medication was supplied in the community pharmacy setting. Pharmacy and pharmacist demographic variables do not appear to affect assessment of asthma control. This research indicates the need for substantial improvements in practice in order to provide reliever medication in line with Quality Use of Medication principles of ensuring safe and effective use of medication.

<http://www.theannals.com/content/43/9/1512.abstract>

157. Intern pharmacists as change agents to improve the practice of nonprescription medication supply: provision of salbutamol to patients with asthma

CR Schneider, AW Everett, E Geelhoed, C Padgett, S Ripley, K Murray, PA Kendall, RM Clifford

Annals of Pharmacotherapy Jul 2010;**44**(7-8):1319-1326

Background: Earlier work established an evidence-practice gap during provision of nonprescription salbutamol (albuterol). Pharmacist interns are hypothesised to be in a position to improve professional practice in the community pharmacy setting.

Objective: To explore the potential of intern pharmacists to improve the professional practice of community pharmacy staff in Australia in the provision of nonprescription salbutamol.

Methods: Intern pharmacists (n = 157) delivered an asthma intervention in 136 pharmacies consisting of an educational activity to pharmacy staff and a health promotion campaign to consumers. Post-intervention, simulated patients presented to 100 intervention and 100 control community pharmacies with a request for

salbutamol. The appropriate outcome was medical referral for poor asthma control and correction of poor inhaler technique. Incidence and quantity of patient assessment and counselling provided during the visit were also assessed. Logistic regression was used to determine the predictors of medical referral.

Results: A doubling in the rate of medical referral was seen in the intervention group (19% vs 40%; $p = 0.001$). Assessment of reliever use frequency was the main predictor of medical referral (OR = 22.7; 95% CI, 9.06 to 56.9). Correction of poor inhaler technique did not improve; however, a reduction in salbutamol supplied without patient assessment (23% vs 8%; $p = 0.009$) or counselling (75% vs 48%; p less than 0.001) was noted.

Conclusions: A doubling in the rate of medical referral showed a clear improvement in professional practice during the provision of nonprescription salbutamol. The improved patient outcome in the intervention group was due to increased assessment of reliever use frequency. Identification of poor inhaler technique remained near zero in both groups, which suggests that intern pharmacists were able to improve the current practice of community pharmacies yet were unable to establish a new practice behaviour. This study provides evidence that intern pharmacists can act as change agents to improve pharmacy practice.

<http://www.theannals.com/content/44/7/1319.abstract>

158. Handling of and preferences for available dry powder inhaler systems by patients with asthma and COPD

M Schulte, K Osseiran, R Betz, M Wencker, P Brand, T Meyer, P Haidl

Journal of Aerosol Medicine and Pulmonary Drug Delivery Dec 2008;**21**(4): 321-328

The correct handling of dry powder inhalers (DPIs) is crucial for efficient therapy, and acceptance of the device can improve compliance. The handling of seven different dry powder inhalers was studied in 72 patients with asthma and chronic obstructive pulmonary disease (COPD). The aim of this study was to identify possible handling errors and investigate patient preferences. Patients inhaled twice with each inhaler; first after reading the device leaflet, and second after device handling was explained by the investigator. The investigator identified handling errors and critical handling errors, which might lead to insufficient or no dose delivery. Afterward, the patients selected their preferred device and judged different aspects of device handling. The lowest number of patients with critical handling errors was observed for the Diskus/Accuhaler, the highest numbers for the Jethaler and the Easyhaler (% of patients during first/second use): Diskus/Accuhaler 25%/13.9% (group A) and 38.9%/8.3% (group B); Clickhaler 50.0%/52.8%, Cyclohaler 58.3%/13.9%, Jethaler 66.7%/30.6% (group A) and Benosid N Inhaler 52.8%/22.2%, Novolizer 52.8%/25.0%, Easyhaler 72.2%/47.2% (group B). Device handling improved after instruction by the investigator. Device handling and preferences of patients closely correlated in this study. Both devices producing the lowest numbers of handling errors (Diskus/Accuhaler and Clickhaler) had the highest preference by the subjects (score from 1 = very good to 7 = very bad): Diskus/Accuhaler 2.21 (group A) and 2.02 (group B); Clickhaler 2.21, Cyclohaler 2.80, Jethaler 3.16 (group A); Novolizer 2.33, Easyhaler 2.37, Benosid N Inhaler 2.43 (group B). Critical handling errors may reduce therapy outcome due to a reduced dose delivery. In addition, reduced patients' acceptance of a device, being dependent on device handling, may have a similar effect by reducing patient compliance.

<http://online.liebertpub.com/doi/abs/10.1089/jamp.2007.0634>

159. Inadequate skill of healthcare professionals in using asthma inhalation devices

TH Self, LB Arnold, LM Czosnowski, JM Swanson, H Swanson

Journal of Asthma 2007;**44**(8):593-598

Inadequate skill in the use of asthma inhalation devices by healthcare professionals has been well documented over the past 25 years. We performed a PubMed search of the English literature for studies regarding skill by physicians, medical students, pharmacists, nurses and respiratory therapists in using asthma inhalation devices. This review summarises 20 studies that were identified. Results of these studies consistently showed lack of skill in using metered-dose inhalers, spacers and dry powder inhalers by a majority of healthcare professionals. National and international guidelines for asthma management include detailed patient education as an essential component of care, yet a large percentage of healthcare professionals are not competent in using inhalation devices. Practical solutions to this problem are needed to enhance the care of asthma patients.

<http://informahealthcare.com/doi/abs/10.1080/02770900701554334>

160. The value of demonstration and the role of the pharmacist in teaching the correct use of pressurized bronchodilators

TH Self, JB Brooks, P Lieberman, MR Ryan

Canadian Medical Association Journal 15 Jan 1983;**128**(2):129-131

29 adult asthmatic patients from an allergy clinic were divided into 3 groups each receiving one of 3 forms of instruction: group 1) Information sheet group 2) Personal instruction group 3) Videotape. Subsequently each patient was tested for correct use of the inhaler. Groups 2 and 3 showed no difference in mean scores for inhalation technique but both were significantly better than the mean score of group 1. These scores demonstrate the need for and the value of demonstration of special technique with pressurised inhalers. A pharmacy-generated education system using videotape equipment or personal instruction by a pharmacist could readily solve the problem.

<http://www.cmaj.ca/content/128/2/129.abstract>

161. Patient perception and acceptability of multidose dry powder inhalers: a randomized crossover comparison of Diskus/Accuhaler with Turbuhaler

J Serra-Batlles, V Plaza, C Badiola, E Morejon

Journal of Aerosol Medicine Mar 2002;**15**(1):59-64

This study was designed to provide information on correct use and preference to features and device handling of two multidose dry powder inhalers, the Diskus/Accuhaler® and the Turbuhaler®. A total of 169 powder-naive patients (mean age 40 years) with asthma or chronic obstructive pulmonary disease (COPD) were enrolled in a randomised, crossover comparison of both inhalers. An effective use of either inhaler was assessed before (leaflet only) and after inhaler education. Ease of use especially during an attack and the presence of a dose counter were regarded as the most important features for an ideal inhaler. The percentage of correct handling manoeuvres and the percentage of patients achieving 100% of correct manoeuvres increased significantly (p less than 0.001) after inhaler education in both devices, but percentage of correct use after the intervention was significantly higher for the Diskus/Accuhaler (92.6%) than for the Turbuhaler (89.8%; $p = 0.036$). Overall 60% of patients thought the Diskus/Accuhaler was preferable to the Turbuhaler (p less than 0.001). The main reasons given were

presence of a dose counter, perceived ease of use including ease of learning to use, design and attached cover. Among those who preferred the Turbuhaler device, the main reason cited was small size, discreetness and ease of holding. In the multivariate analysis, inhaler education ($p = 0.005$) and education level ($p = 0.009$) were significantly associated with the percentage of correct manoeuvres. Age, sex or inhaler tested showed no effect on appropriateness of the inhalation technique.

<http://online.liebertpub.com/doi/abs/10.1089/08942680252908584>

162. Prescription bias and factors associated with improper use of inhalers

P Sestini, V Cappiello, M Aliani, et al.

Journal of Aerosol Medicine Jun 2006;**19**(2):127-136

This multicentre, observational study using a self-administered questionnaire analysed the characteristics of a large sample of Italian patients ($n = 1305$; 55% female; mean age 57.4, range of 15–88 years), most suffering from asthma or chronic obstructive pulmonary disease (COPD), familiar with several different types of inhalers in relation to their most commonly used delivery device. Data on the inhalation technique for 2057 observations of 1126 patients using device-specific checklists and factors associated to misuse were also evaluated. Prevalent usage of newer dry powder inhalers (DPIs) was significantly associated with male sex, higher education, better respiratory function and prescription from a respiratory physician. Patients using DPIs had received less instruction by health caregivers and were more likely to have read the instruction leaflet than users of metered dose inhalers (MDIs). Under these conditions, inhaler misuse was common and similar for both pressurised metered dose inhalers (pMDIs) and DPIs. For both types of inhalers, misuse was significantly and equally associated to increased age, less education and less instruction by health care personnel. Concludes that many doctors are not familiar with the relevant characteristics of currently available inhalers. The prescription of newer DPIs may be subjected to gender, socio-economic and instruction bias. A simple change of device from the pMDI to the newer DPIs is not associated with improved inhalation technique.

<http://online.liebertpub.com/doi/abs/10.1089/jam.2006.19.127>

163. Metered-dose inhaler technique of patients in an urban ED: prevalence of incorrect technique and attempt at education

M Shrestha, MF Haroon Parupia, B Andrews, SW Kim, TS Martin, DI Park, E Gee

American Journal of Emergency Medicine Jul 1996;**14**(4):380-384

The metered-dose inhaler (MDI) techniques of 125 asthma patients who presented to a county hospital emergency department (ED) in the USA were evaluated. Correct technique was divided into 7 steps. 21% of the patients performed all 7 steps correctly. Mean number of steps \pm SD performed correctly was 4.8 \pm 1.7. Verbal individualised instruction was used to improve the technique of patients whose technique was less than perfect. The instruction required a mean \pm SD of 8.3 \pm 5.8 minutes (range, 0 to 30) for all 7 steps to be done correctly at least once. All patients were able to perform all steps correctly after instruction. The amount of time required for teaching was proportional to the number of steps performed incorrectly. The Vitalograph Aerosol Inhalation Monitor was used to verify correct patient technique and as a teaching aid with variable success. Education in proper use of the MDI is important in the overall care of the asthma patient; however, instruction requires a definite time commitment and may not be feasible for all patients in a busy ED. For some patients, alternatives that require less

lengthy instruction, such as the use of breath-actuated devices, spacers and reservoirs, may be required.

<http://www.sciencedirect.com/science/article/pii/S0735675796900546>

164. Provider demonstration and assessment of child device technique during pediatric asthma visits

B Sleath, GX Ayala, C Gillette, D Williams, S Davis,

Pediatrics Apr 2011;**127**(4):642-648

Objective: The purposes of this study were to (a) describe the extent to which children use metered dose inhalers, Turbuhalers, Diskuses and peak flow meters correctly, and (b) investigate how often providers assess and demonstrate use of metered dose inhalers, Turbuinhalers, Diskuses and peak flow meters during paediatric asthma visits.

Patients and Methods: Children aged 8 to 16 years with mild, moderate or severe persistent asthma and their caregivers were recruited at 5 paediatric practices in nonurban areas of North Carolina, USA. All of the medical visits were audiotape-recorded. Children were interviewed after their medical visits, and their device technique was observed and rated by the research assistants.

Results: Of the patients, 296 had useable audiotape data. Only 8.1% of children performed all of the metered dose inhaler steps correctly. Older children were more likely to get more of the metered dose inhaler steps correct. Of the children, 22% performed all of the Diskus steps correctly, 15.6% performed all of the Turbuhaler steps correctly and 24% performed all of the peak flow meter steps correctly. The majority of providers did not demonstrate or assess child use of metered dose inhalers, Turbuhalers, Diskuses or peak flow meters during paediatric asthma visits. Conclusions: There is a need for providers to demonstrate proper asthma medication and monitoring device techniques to children and to have children demonstrate to proficiency. The 2007 US National Heart, Lung, and Blood Institute expert panel report on the diagnosis and management of asthma encourages providers to educate children on these techniques.

<http://pediatrics.aappublications.org/content/127/4/642.abstract>

165. Metered dose inhalers: the value of instruction

D Smith

Practitioner 9 May 1988;**232**:507-510

Study of 33 patients (15 men, 18 women; mean age 50.5yr) to assess inhaler technique. Baseline respiratory function and symptom scores were obtained and then, using a rimiterol inhaler (2 puffs; 400microg), technique was assessed using a scoring system. Further spirometry was performed at 2 and 5min to measure reversibility of airflow obstruction. 14 patients had excellent technique and better symptom scores than those with poor scores. 9 patients with unsatisfactory results were shown how to use the inhaler correctly. Inhaler technique was checked 1 week later when it had improved by 28%; symptoms by 14% and reversibility of airflow obstruction improved. A list of faults in technique is given. Authors conclude that the full benefit of improving inhaler technique would have been more obvious over one month.

166. Metered dose inhaler-spacer technique in hospitalized geriatric patients: effect of patient education by a pharmacist

VS Smith

Hospital Pharmacy Feb 2000;**35**(2):162-164

This study examined whether counselling by a pharmacist on the correct inhaler and spacer technique would improve technique in 23 geriatric patients.

167. Inhaler technique - a pilot study comparing verbal and computer counselling

LJ Stapleton, H Liddell, MJ Daly

Pharmaceutical Journal 22 Jun 1996;**256**:866-868

The incorrect use of inhaler devices by asthma patients has serious implications for the effectiveness of treatment. The present study investigates the benefits of using an interactive computerised counselling system to demonstrate the correct use of metered dose inhalers (MDIs). 81 patients attending a community pharmacy received either verbal counselling with a demonstration of MDI use, or computerised counselling alone. While hand-lung coordination was least improved in the computer-counselled group, this group demonstrated significantly better recall of instructions after 4 weeks. The results indicate that computerised patient counselling provides a useful addition to, but not a substitute for, verbal counselling by a health care professional. (16 refs.)

168. Development and evaluation of a pharmacist-managed asthma education clinic

SC Sterne, BP Gundersen, D Shrivastava

Hospital Pharmacy Jun 1999;**34**(6):699-706

A study in 22 asthmatic patients referred to a pharmacist-run educational clinic. Patients were taught about the appropriate use of their medications and were assisted with their MDI and peak flow techniques. An asthma self-management plan was developed for each patient. After education, 18 of 20 patients were using MDIs correctly, compared with 5 of 20, prior to education. The pharmacist-educated patients had a 40% reduction in hospital admissions and a 66% reduction in emergency department visits related to asthma. (6 refs.)

169. Assessment of inhaler technique in the elderly using checklists and an electronic device

T Stevenson, MW Loh

Progress in Practice, - UK Clinical Pharmacy Association Symposium, Blackpool, 9-11 May 1997, p.4-5

Metered dose inhalers (MDI) deliver only 10% of the inhaled dose to the site of action. Poor inhaler technique further reduces the delivery of drug, affects 50-65% of patients and may contribute to admissions due to poorly controlled asthma. The assessment of inhaler technique in practice relies on subjective observation. The use of checklists or an electronic device such as the Aerosol Inhalation Monitor (AIM) provides a more objective assessment. This study of forty elderly patients using MDIs was designed to assess inhaler technique using four existing checklists from the literature and the AIM device. Video recordings were made of inhaler technique pre- and post-counselling to enable an independent observation of technique. Checklists were compared statistically and, individually, against the AIM device. 93% of the patients used their MDIs regularly. 55% had been using it for between 6 months to 5 years and 20% had been receiving an MDI for more than 10 years. 38% of patients said they had not been shown how to use their inhaler when treatment was first initiated. Only 28% of elderly patients stated their technique had been reassessed since being prescribed a metered dose inhaler. From the checklist scores,

43% of patients were judged to have a poor technique. Furthermore the use of AIM device revealed poor inspiratory flow rates and less than 18% of patients could actually be classed as having a 'good' technique. There was no significant difference between the results obtained from three of the four checklists used. These three checklists were found to produce results, which were significantly different from the AIM device (p less than 0.05) by tending to overestimate the effectiveness of patients' inhaler technique. A new assessment tool was produced to minimise problems highlighted with existing checklists and contained additional stages to incorporate issues raised during the AIM machine assessment. The new tool was more sensitive than previous checklists in the detection of improved technique post-counselling.

170. Asthma in primary schools

J Storr, E Barrell, W Lenney

British Medical Journal 25 Jul 1987;**295**(6592):251-252

Report of survey of 7 primary schools in the Lewes area to determine attitudes of parents and teachers to childhood asthma and to identify problems associated with use of inhalers at school. 76 children (32f, 44m; 4-12yr) were using inhalers; 67 questionnaires were completed. Most children had never been in hospital with asthma but 26 had had 1-25 admissions. 48 used Rotahalers, 16 pressurised inhalers and 3 spacer devices. The inhalers were used from occasionally to 20 times per day; median, bd for minimum use, qds for average use and eight times daily for maximum use. 2 had home nebulisers, 11 were on regular inhaled steroid and 17 on cromoglycate. One child received regular theophylline and 1 had theophylline for exacerbations. Details are given of possible precipitants of asthma in these children, measures taken by parents to reduce asthmatic problems and parents' attitudes to medication. Results of peak expiratory flow rates following exercise are included. 11 of 16 were unable to coordinate pressurised inhalers correctly and 19 of 48 were not using Rotahalers correctly. Full details are given of attitudes of teachers to asthma and inhalers and use of inhalers by the children during school hours. The authors conclude that pressurised inhalers are being given to children too young to use them correctly or who have not received adequate instruction. Regular checks of inhaler and Rotahaler technique are necessary. They also advise that school nurses should be more involved and that teachers need instruction in asthma and the use of inhalers for treatment. Lectures arranged for teachers in Brighton were well attended.

http://www.bmj.com/highwire/filestream/298428/field_highwire_article_pdf/0.pdf

171. Repeated instruction on inhalation technique improves adherence to the therapeutic regimen in asthma

M Takemura, M Kobayashi, K Kimura, et al.

Journal of Asthma Mar 2010;**47**(2):202-208

Background: Adherence to inhalation therapy is a critical determinant of the success of asthma management. Reasons for nonadherence have been well studied, but reasons for good adherence are poorly understood. Understanding the mechanisms of adherence to inhalation therapy is important in developing strategies to promote adherence. The objective of this study was to assess the factors and mechanisms that contribute to and the clinical outcomes relating to adherence to inhalation therapy.

Methods: The factors and outcomes related to adherence to inhalation therapy were examined cross-sectionally in 176 adults with asthma using a self-reported

adherence questionnaire that consisted of four items dealing with the use of inhaled controller medications. A 5-point Likert scale was used for the responses to each item. Adherence was assessed based on the overall mean adherence score. Results: Of the 176 patients who were potential participants, 146 (83%) responded with usable information. Significant factors associated with the overall mean adherence score were older age ($r = 0.18$, $p = 0.032$) and receiving repeated instruction on inhalation techniques ($p = 0.0016$). Of the 146 respondents, 25 (17.1%) patients were given repeated verbal instruction or demonstrations of inhalation technique by a respiratory physician. On logistic regression analysis, good adherence to inhalation therapy was significantly related to the receiving of repeated instruction on inhalation technique, with an odds ratio of 2.90 (95% CI, 1.07 to 7.88; $p = 0.037$). Furthermore, less intentional nonadherent behaviour was reported in patients with repeated instruction on inhalation technique compared to those without it. A significant correlation was found between the overall mean adherence score and the frequency of asthma exacerbations ($r = -0.19$, $p = 0.021$), emergency room visits ($r = -0.19$, $p = 0.042$), and the health-related quality of life score (St. George's Respiratory Questionnaire: Total, $r = -0.22$, $p = 0.024$; Symptoms, $r = -0.21$, $p = 0.022$; Impacts, $r = -0.20$, $p = 0.035$). Conclusions: Repeated instruction on inhalation techniques may contribute to adherence to inhalation therapy through decreasing intentional nonadherence. Furthermore, good adherence to the therapeutic regimen may offer good asthma-related outcomes.

<http://informahealthcare.com/doi/abs/10.3109/02770900903581692>

172. Impact of a network system for providing proper inhalation technique by community pharmacists

M Takemura, K Mitsui, M Ido, M Matsumoto, M Koyama, et al.

Journal of Asthma Jun 2012; **49**(5):535-541

Objective: The availability of many types of inhalers in the treatment of asthma has resulted in a wide range of prescription choices for clinicians. With so many devices available, however, there is some confusion regarding their proper use among both medical staff and patients. Since 2007, Kitano Hospital and Kita-ku Pharmaceutical Association, Osaka, Japan, have provided a network system for delivering instruction on correct inhalation technique through community pharmacists. We examined the clinical effects of this network system.

Methods: Our measurements included the manner in which community pharmacists instruct patients with asthma, the frequency of asthma exacerbations, patients' adherence to inhalation therapy using a 5-point Likert scale questionnaire, and patients' health status both prior to this system and at 4 years after.

Results: Usable information was obtained from 53 community pharmacists and 146 patients with asthma at baseline and from 60 community pharmacists and 148 patients at 4 years. When compared with baseline values, significant improvement was found in pharmacists' instruction and significant decreases were observed in the frequency of asthma exacerbations (1.4 +/- 1.6 vs 1.0 +/- 1.4 times/year, $p = 0.042$) and emergency room visits (0.5 +/- 1.0 vs 0.2 +/- 0.5 times/year, $p = 0.004$). Adherence to the inhalation regimen significantly increased (4.0 +/- 0.7 vs 4.2 +/- 0.8, $p = 0.041$), but health status was unchanged.

Conclusions: This network system may improve asthma control and adherence to inhalation regimens.

<http://informahealthcare.com/doi/abs/10.3109/02770903.2012.663847>

173. Use of bronchodilator aerosols

MJ Tobin

Archives of Internal Medicine Sep 1985;**145**(9):1659-1663

A review of the administration of bronchodilator drugs by metered dose inhalers (MDI). The author discusses the fears that arose about MDI therapy after their introduction in the United States and the epidemic of asthmatic deaths which followed. The author suggests that the increased death rate may have been caused by patient over-reliance on MDIs which led to a failure to receive medical care sufficiently early. Advantages of bronchodilator therapy are discussed and factors determining the efficacy of inhaled bronchodilators reviewed. Suggested patient instructions for the use of MDIs are given. In addition auxiliary aerosol delivery systems, such as breath-actuated pressurised aerosol inhalers, spacers, reservoir bottles, Aerochambers, reservoir aerosol delivery systems and breath-actuated powder inhalers are discussed. Comments that, because many physicians are unaware of the optimal technique in employing an MDI, it is not surprising that patients frequently receive little or no instructions in its use. Furthermore, patients who have received instruction display great difficulty in adhering to the steps in the ideal use of an MDI and frequently cannot coordinate MDI actuation with inspiration.

<http://archinte.ama-assn.org/cgi/content/abstract/145/9/1659>

174. Comparison of small-group training with self-directed Internet-based training in inhaler techniques

M Toumas, IA Bsheti, SZ Bosnic-Anticevich

American Journal of Pharmaceutical Education 2009;**73**(5):Art 85

Pharmacy students at the University of Sydney, Australia, were randomly allocated to 1 of 2 groups: small-group training (n = 123) or self-directed Internet-based training (n = 113). Prior to intervention delivery, all participants were given a placebo Turbuhaler and product information leaflet and received inhaler technique training based on their group. Technique was assessed following training and predictors of correct inhaler technique were examined. There was a significant improvement in the number of participants demonstrating correct technique in both groups (small group training, 12% to 63%; p less than 0.05; and Internet-based training, 9% to 59%; p less than 0.05) post-intervention, with no significant difference between the groups in the percentage change (n = 234, p greater than 0.05). Increased student confidence following the intervention was a predictor for correct inhaler technique. Concludes that self-directed Internet-based training is as effective as small-group training in improving students' inhaler technique. (26 refs.)

<http://www.ajpe.org/doi/pdf/10.5688/aj730585>

175. Metered dose inhalers: a system for assessing technique in patients and health professionals

P Tunstell, D Taylor

Pharmaceutical Journal 18 May 1991;**246**:626-627

A scoring system was developed to assess metered dose inhaler (MDI) technique of patients and health care staff. One point was scored for each of the 10 actions performed correctly. MDI technique was tested in 28 inpatients, 16 pharmacy technicians, 25 hospital pharmacists, 31 nurses and 16 physiotherapists. The median scores (out of 10) for each group were 6.5, 4.0, 8.0, 5.0 and 8.0 respectively. The numbers scoring 9-10 were 28%, 6%, 48%, 13% and 43% respectively. The authors conclude that there is a need to improve the education of health professionals

involved in counselling patients on the use of MDIs, and pharmacists at the authors' hospital now undergo training.
See also Reference 30.

176. Assessment of the inhalation technique in outpatients with asthma or chronic obstructive pulmonary disease using a metered-dose inhaler or dry powder device

I van Beerendonk, I Mesters, A Mudde, TD Tan

Journal of Asthma 1998;**35**(3):273-279

A total of 316 patients suffering from asthma or COPD took part in a study that evaluated how patients utilised their metered-dose inhaler (MDI) or dry powder inhaler, using a standardised inhaler checklist. 281 patients (88.9%) made at least one mistake in the inhalation technique. The mistakes were classified into skill and nonskill mistakes. 200 patients made one or more skill mistakes and 81 patients only made one or more nonskill mistakes. The most common skill error was 'not continuing to inhale slowly after activation of the canister' (69.6%). The nonskill item most patients had difficulties with was 'exhale before the inhalation' (65.8%). Patients who used a MDI made significantly fewer nonskill mistakes than patients using a dry powder device. Older patients had more difficulty with the correct use of the inhaler than younger patients. There was no difference in errors between men and women. Concludes that in this patient sample, most patients failed to use their inhaler correctly. Regular instructions and checkups of inhalation technique are the responsibility of the physician and should be a standard and routine procedure.

<http://informahealthcare.com/doi/abs/10.3109/02770909809068218>

177. Comparison of the Diskus inhaler and the Handihaler regarding preference and ease of use

J van der Palen, MM Eijsvogel, BF Kuipers, M Schipper, NA Vermue

Journal of Aerosol Medicine Mar 2007;**20**(1):38-44

Study aimed to establish whether there was a difference in preference and ease of use between Diskus (DK) and Handihaler (HH, Boehringer Ingelheim) inhalers and how acceptable were their inhalation resistances to patients. 60 COPD patients in the Netherlands, naive to DK and HH, but experienced in the use of other inhalers, had to read the instruction leaflet and demonstrate their inhalation technique. If errors were made, instruction was given and inhalation technique was checked again. Patients had to state a preference for DK or HH. Subsequently they inhaled through a range of resistances and scored the acceptability. There was no difference in the number of instructions needed for both inhalers. One-third inhaled perfectly after reading the instruction leaflet, which increased to 85% after one instruction. More patients preferred the DK (43) than the HH (16). Acceptability increased with decreasing resistance, but then reached a plateau. Concludes that patients have a clear preference for the DK. There is no difference in the number of instructions needed to obtain a perfect inhalation technique, but for some patients one instruction is not enough. The trend to increase the resistance of inhalers has reached a critical point with regard to acceptability.

<http://online.liebertpub.com/doi/abs/10.1089/jam.2006.0565>

178. Inhalation technique of 166 adult asthmatics prior to and following a self-management program

J van der Palen, JJ Klein, AHM Kerckhoff, CL van Herwaarden, et al.

Journal of Asthma 1999;**36**(5):441-447

Self-management of asthma and self-treatment of exacerbations are considered important in the treatment of asthma. For successful self-treatment, medication has to be inhaled correctly, but the percentage of patients inhaling effectively varies widely. As part of a self-management programme we checked and corrected inhalation technique. This paper addresses differences among inhalers in relation to patient characteristics and the effect of instruction, 1 year after enrollment. Manoeuvres that are essential for adequate inhalation were identified. When errors in inhalation technique were observed, patients were instructed in the correct use of their devices. One year later, inhalation technique was checked again. Only patients who used the same inhaler throughout the entire study period were analysed. Of the 245 adult asthmatic patients who were enrolled in the self-management programme, 166 used the same inhaler throughout the study period. 120 patients (72%) performed all key items correctly at baseline and this increased to 80% after 1 year. At follow-up, older patients were less likely to demonstrate a perfect inhalation. Patients with a Diskhaler(R) made fewest errors. Adjustment for differences in patient characteristics did not significantly change the results. Because many patients with asthma use their inhaler ineffectively, there is a need to know which inhaler leads to fewest errors. Diskhaler was nominated by this study. When patients are not able to demonstrate adequate inhalation technique in a 'tranquil' setting, it is doubtful whether they can do so when they experience an exacerbation. Therefore, inhalation instruction should be considered an essential ingredient, not only of self-management programmes, but also of asthma patient care in general.

<http://informahealthcare.com/doi/abs/10.3109/02770909909087286>

179. Effects of instruction by practice assistants on inhaler technique and respiratory symptoms of patients. A controlled randomized videotaped intervention study

S Verver, M Poelman, A Bogels, et al.

Family Practice Feb 1996;**13**(1):35-40

Study of 40 patients in the Netherlands (29 men, 19 women; mean age 53yr, range 15-85yr) who had used one or more type of dry powder inhaler (40 Rotahaler, 6 Diskhaler, 4 Ingelheim Inhaler, 3 Spinhaler, 3 Cyclohaler, 2 Turbuhaler) for periods from 1 month to 22 years. 25 patients were randomised to receive instruction from a practice assistant, and the other 23 served as a control group. Inhaler technique was assessed on two visits, before and after intervention, using videotapes which were assessed blind by two investigators. Mean numbers of mistakes on the two visits were 1.9 and 2.1 in the control group, and 2.0 and 1.4 in the intervention group. Improvement was significantly better in the intervention group. Only 6% of patients made no mistakes on the first visit, and 23% of all patients reported that they had received no previous instruction in inhaler technique. (29 refs.)

<http://fampra.oxfordjournals.org/content/13/1/35.abstract>

180. Assessment of inhalation technique and determinants of incorrect performance among children with asthma

M Walia, L Paul, A Satyavani, R Lodha, M Kalaivani, SK Kabra

Pediatric Pulmonology Nov 2006;**41**(11):1082-1087

The objective of our study was to evaluate the pressurised metered dose inhaler (pMDI) with holding chamber technique of asthmatic children attending an outpatient paediatric chest clinic in New Delhi, India, and to determine factors associated with incorrect technique. All patients had previously received instructions regarding

inhalation technique. The inhalation technique was assessed on a 5-point checklist, of which 4 were considered essential. 213 children (mean +/- SD age, 7.3 +/- 3.8 years; 151 boys) completed the study. Children were using their inhaler for a median duration of 6 months (range 1 to 96 months). 188 patients (88.3%) performed all essential steps correctly. The commonest mistake among the essential steps was not shaking the inhaler (n = 21, 9.9%) followed by inability to make a tight seal around the mouthpiece of the holding chamber (n = 12, 5.6%). Correct technique was not affected by gender, asthma severity and socio-economic indices: education level of parents, per capita monthly income, rural or urban background. Our study indicates that a large majority of children from a developing country setting, irrespective of lower education and income levels can be successfully educated to use inhalation devices appropriately. Inhalation performance is not affected by socio-economic background of the patients. Comprehensive inhalation instructions and monitoring at each visit are however critical to ensure reliable and consistent performance of correct technique among asthmatic children.

<http://onlinelibrary.wiley.com/doi/10.1002/ppul.20498/abstract>

181. Readability characteristics of consumer medication information for asthma inhalation devices

LS Wallace, SE Roskos, BD Weiss

Journal of Asthma 2006;**43**(5):375-378

Purpose: Successful control of asthma relies heavily on patient adherence to prescribed inhalation therapies. Many patients are unable to use inhalers correctly and, therefore, do not reap the full therapeutic benefits. The purpose of this study was to assess the readability and related characteristics of Consumer Medication Information (CMI) for all prescription asthma inhalation devices currently available in the United States.

Methods: We identified all brand-name (n = 18) and generic (n = 2) asthma inhalation devices currently available in the United States. English language CMI was obtained from pharmaceutical manufacturers of each identified product. The CMI from these products was evaluated for readability characteristics, including reading grade level using the Fry formula, text point size, dimensions (length and width), diagrams, and directions.

Results: The mean Fry readability of the CMI was at grade level 8.2 +/- 1.5 (range = 5-11), while the average text point size was 9.2 +/- 2.2 (range = 6-12). The mean length of the pages on which the CMI was printed was 33.7 +/- 21.5 cm, while the average width of pages was 12.9 +/- 9.5 cm. There was an average of 6.2 +/- 3.6 (range = 2-12) illustrations per CMI, while a device overview diagram was included in 14 (70%). Eleven (n = 11) instructions included detailed step-by-step diagrams to supplement directions.

Conclusions: Overall, most CMI for prescription inhalers is presented with a reading difficulty level, text size, diagrams and instructions that make it suboptimal for patient education. Prescription inhaler manufacturers should consider revising their CMI to comply with generally accepted guidelines preparing patient education information.

<http://informahealthcare.com/doi/abs/10.1080/02770900600709856>

182. Evaluation of inhaler device technique in caregivers of young children with asthma

MJ Welch, ML Martin, PV Williams, CL Gallet, et al.

Pediatric Allergy, Immunology, and Pulmonology Jun 2010;**23**(2): 113-120

Inhalation therapy has become the primary treatment mode for most paediatric pulmonary diseases. Errors in inhalation technique can decrease intrapulmonary drug deposition, which may lead to a decrease in therapeutic response. This study examined the ability of caregivers of young children with asthma, after being provided careful and standardised instruction, to correctly demonstrate how to use 1 of 2 different inhaler delivery systems. Caregivers of children aged 1-6 years, who were being prescribed an inhaler device for the first time, were trained by a staff asthma educator using a standardised educational checklist. One week later, the caregiver was required to demonstrate the correct preparation, use and maintenance of their prescribed device to a different staff asthma educator, who rated their performance using the same standardised educational checklist. Errors (total and major) in carrying out the individual steps for each delivery device were recorded, and a Performance Mastery Score (measure of ability to do device steps correctly) was calculated. The total and major error rates were 24.8% and 15.6%, respectively, for the metered-dose inhalers (MDIs) with spacer, and 15.9% and 8.5%, respectively, for the nebuliser (P less than 0.001). The mean Performance Mastery Score was 84.5% for the MDI with spacer and 91.9% for the nebuliser (P less than 0.001). Caregivers of young children with asthma demonstrate a number of errors in device use, including major ones that can potentially result in poor lung delivery, even 1 week after standardised training by an asthma educator. Mastery of the MDI with spacer delivery system appears somewhat harder than that seen with the nebuliser. These findings suggest the need for repetition of sessions reinforcing inhalation instructions at follow-up in addition to initial education of proper device use, no matter what type of delivery system is selected.

<http://online.liebertpub.com/doi/abs/10.1089/ped.2010.0020>

183. Comparison of patient preference and ease of teaching inhaler technique for Pulmicort Turbuhaler versus pressurized metered-dose inhalers

MJ Welch, HS Nelson, G Shapiro, et al.

Journal of Aerosol Medicine Summer 2004; **17**(2):129-139

A multicentre, randomised, open-label, crossover study with two 4-week evaluation periods compared patient preference and ease of teaching correct inhaler technique for Pulmicort Turbuhaler versus pressurised metered-dose inhalers (pMDIs). Patients 18 to 65 years of age with stable, mild to moderate asthma, who required or were eligible for inhaled corticosteroid therapy, were randomised to treatment sequences consisting of 4-week evaluation periods with Pulmicort Turbuhaler (budesonide inhalation powder) two puffs (400 microg) bid and one of three inhaled corticosteroids via pMDI: Aerobid-M (flunisolide) four puffs (1mg) bid, Flovent (fluticasone propionate) two puffs (440 microg) bid, or Vanceril Double Strength (beclomethasone dipropionate) five puffs (420 microg) bid. Patients indicated device preference at study end and completed the Patient Device Experience Assessment (PDEA) questionnaire after each evaluation period. Ease of teaching, time required to master use of the device, percentage of patients demonstrating mastery on the first attempt, and the number of attempts required to demonstrate mastery were assessed. Despite previous use of pMDIs by most patients, Pulmicort Turbuhaler was significantly preferred (p less than 0.001) and required significantly less time to master than pMDIs (p less than 0.001). Median times to device mastery were 3.67 min for Pulmicort Turbuhaler versus 5.33 min for pMDIs. Patients rated Pulmicort Turbuhaler significantly better than pMDIs on PDEA ease of use (p = 0.0005) and overall satisfaction (p less than 0.0001) single-item scales and all four multi-item

scales (pharyngeal symptoms, oral sensation, operational use and inhaler attributes; p less than 0.05). Overall, patients preferred Pulmicort Turbuhaler over pMDIs and required less time to be taught how to correctly use Turbuhaler.

<http://online.liebertpub.com/doi/abs/10.1089/0894268041457174>

184. The community pharmacist, the patient and the inhaler device – time to work together?

M Wilcock

Pharmacy in Practice Nov 2002;**12**(9):356-359,361-362

An article reporting the results of a study in which pharmacists checked the inhaler technique of patients presenting prescriptions for inhaler devices at community pharmacies. Patients were re-audited after being given information on the correct use of inhalers.

185. Problems in assessing contents of metered dose inhalers

DJ Williams, AC Williams, DG Kruchek

British Medical Journal 25 Sep 1993;**307**(6907):771-772

An investigation of 51 asthmatic patients aged 13-22 years revealed that the majority could not reliably assess when an inhaler was almost empty and more than half of the patients had run out of medication at some time and had consequently become wheezy. Aerosol metered dose inhalers should include a counter mechanism to enable the patient to determine the amount of drug in the inhaler.

http://www.bmj.com/highwire/filestream/359712/field_highwire_article_pdf/0/771.full.pdf

186. A cross sectional survey of inhaler technique and training among Dundee medical students

PA Williamson, L McKinlay, B Ho, AY Mohammed, BJ Lipworth

Journal of Allergy and Clinical Immunology Feb 2011;**127**(2-Suppl):AB117

Rationale: Healthcare providers are not fully competent in the skills required to deliver inhaler device education to patients. This has also been shown in undergraduate trainees. Inhaler education remains a cornerstone in the accurate management of asthmatics. This will inevitably lead to the detriment of patients as they are likely only to be as good with inhaler device and technique as their instructor/educator. If this is to be improved, then proper training should be applied at all levels of healthcare providers that deliver such education to patients. The aim of this survey was to determine the level of inhaler education among medical students.

Methods: Approximately 100 undergraduate MBChB students were invited to participate in this survey at random. They were asked to complete an anonymised questionnaire with only their year of study made known for subsequent analyses. They were also assessed on their pressurised metered dose inhaler technique by use of an aerosol inhalation monitor. Visual analogue scores were used to determine students' confidence with inhaler technique.

Results: 56% of students had received training on inhalers. Mean confidence levels of all students was 34%. 70% of students knew when was appropriate to check inhaler technique. 88% of all students felt they required further training.

Conclusions: Training and education should be improved which may ultimately lead to better control, improved concordance and reduced side effects of therapy.

[http://www.jacionline.org/article/S0091-6749\(10\)02412-7/fulltext](http://www.jacionline.org/article/S0091-6749(10)02412-7/fulltext)

187. Use of dry powder inhalers in COPD

DS Wilson, MS Gillion, PJ Rees

International Journal of Clinical Practice Dec 2007;**61**(12):2005-2008

Study of 30 chronic obstructive pulmonary disease (COPD) patients to assess the ease of use and preference of four dry powder inhalers - Accuhaler, Aerolizer, Handihaler, Turbohaler – the Accuhaler and Turbohaler are multidose devices, whereas the Aerolizer and Handihaler are single-dose devices. Subjects were shown the correct technique for each inhaler in a random order and were assessed immediately and 1 hour later. Each subject was asked to rank the 4 devices for preference and ease of use, as well as to assess how comfortable it felt to inhale through the device using a visual analogue scale. The numbers of perfect scores were not significantly different between devices, but the number of fatal errors that would result in no drug delivery was significantly more common in single dose devices (p less than 0.01). There were significant differences in the rankings of each device (Friedman test, p less than 0.005) with the Turbohaler being ranked first most often and the Handihaler last. The Turbohaler scored highest for comfort of inhalation and the Accuhaler lowest, but differences were small.

<http://onlinelibrary.wiley.com/doi/10.1111/j.1742-1241.2007.01593.x/abstract>

188. Media and memory: the efficacy of video and print materials for promoting patient education about asthma

EAH Wilson, DC Park, LM Curtis, KA Cameron, ML Clayman, G Makoul, K vom Eigen, MS Wolf

Patient Education and Counseling Sep 2010;**80**(3):393-398

Objective: We examined the effects of presentation medium on immediate and delayed recall of information and assessed the effect of giving patients take-home materials after initial presentations.

Methods: Primary-care patients received video-based, print-based or no asthma education about asthma symptoms and triggers and then answered knowledge-based questions. Print participants and half the video participants received take-home print materials. A week later, available participants completed the knowledge assessment again.

Results: Participants receiving either intervention outperformed controls on immediate and delayed assessments (p less than 0.001). For symptom-related information, immediate performance did not significantly differ between print and video participants. A week later, receiving take-home print predicted better performance (p less than 0.05), as did self-reported review among recipients of take-home print (p less than 0.01). For content about inhaler usage, although video watchers outperformed print participants immediately after seeing the materials (p less than 0.001), a week later these two groups' performance did not significantly differ. Among participants given take-home materials, review predicted marginally better recall ($p = 0.06$).

Conclusions: Video and print interventions can promote recall of health-related information. Additionally, reviewable materials, if they are utilised, may improve retention.

Practice implications: When creating educational tools, providers should consider how long information must be retained, its content, and the feasibility of providing tangible supporting materials.

[http://www.pec-journal.com/article/S0738-3991\(10\)00412-X/abstract](http://www.pec-journal.com/article/S0738-3991(10)00412-X/abstract)

189. An evaluation of metered dose inhaled technique in patients attending a general hospital

PM Wilson, GW Burdon

Australian Journal of Hospital Pharmacy Feb 1989;**19**:6-9

102 patients (57 male, 45 female, mean age 61yr) with chronic airflow obstruction or asthma, attending a hospital clinic and using a metered dose inhaler (MDI) were selected. 43 were attending the respiratory medicine clinic (RMC). Patients' ability to use metered dose inhalers was assessed. Patients from the RMC were found to be significantly more proficient than those patients attending other clinics. Patients using more than 1 MDI were more proficient than those using 1 MDI. Inhaler technique tended to improve with increasing duration of use. The majority of patients were instructed in MDI technique by the doctor. Only 2 patients were taught by a pharmacist and 3 patients received no instruction. Package inserts were found to be a useful adjunct to verbal tuition. Details of common errors in technique are given. The authors conclude that considerably more attention to inhaler technique needs to be undertaken by both doctors and paramedical personnel. They make 4 recommendations.

190. A controlled trial of two forms of self-management education for adults with asthma

SR Wilson, P Scamagas, DF German, GW Hughes, et al.

American Journal of Medicine Jun 1993;**94**(6):564-576

Study of 323 adults with moderate to severe asthma who were members of the Northern California Region of the Kaiser Permanente Medical Care Program. Patients were randomised to receive (1) a small-group education programme taught by a nurse-educator (four 90-minute sessions), (2) individual education sessions, (3) an 80-page workbook covering the same educational objectives, or (4) no education (controls). Improvements in number of days with symptoms, physician evaluation of asthma, and physical activity were observed with some or all of the active treatments, and these patients also had fewer acute medical visits due to exacerbation of asthma. There were no significant changes in drug regimen (typically 4 or 5 daily drugs not including oral corticosteroids) or in rates of hospital admission attributed to the programmes. At baseline, 75% of patients did not use metered dose inhalers correctly, and both individual and group education resulted in a significant improvement in technique (although this was not judged to account for all the observed improvement in symptoms). (25 refs.)

<http://www.sciencedirect.com/science/article/pii/0002934393902065>

191. Introducing a technician-led inhaler counselling service

A Woods, ML Currie, MG Scott, JC McElnay

Hospital Pharmacist Nov 2005;**12**(10):417-418

Article about a technician-led inhaler counselling service at the United Hospitals Trust, in Northern Ireland. (6 refs.)

192. Breaking down bad inhaler technique: device specific advice

S Zaidi, J Williams, S Mault, N Garner, H Burhan

American Journal of Respiratory and Critical Care Medicine 1 May 2012;**185**(Suppl):A3332

Paper presented at the American Thoracic Society 2012 International Conference, San Francisco, California, USA, 18-23 May 2012.

193. Isle of Wight respiratory inhaler project

P Jerram

NICE Shared Learning Database, updated 11 Feb 2011

Aim: To reduce respiratory deaths, hospital admissions and the cost of respiratory medication.

Objectives: To reduce respiratory deaths, hospital admissions and the cost of respiratory medication.

Context: The Isle of Wight had a high prevalence of long term respiratory conditions combined with a much higher than average, spend on medication for treatment. Despite the higher spend, clinical outcomes were poor, with a greater number of respiratory related emergency hospital admissions than expected. Reasoning from the disparity between spend on medication and the high level of emergency hospital admissions that simply investing more money in medication wasn't addressing the issue, the PCT began tackling the effectiveness of inhaler use.

Methods: When used effectively, 20% of the medication in a metered dose inhaler (MDI) reaches the lungs (the other 80% being swallowed), whereas with a poor technique the percentage drops to between 0 and 10%. Therefore an intervention to improve inhalation techniques was identified as a cost effective way of improving performance. A review of the training techniques of Health Care Professionals (HCPs) with a role to play in delivering inhaler training, revealed a very low level of performance across the board with 94% of HCPs unable to even demonstrate the ability to use the inhaler correctly for themselves. Tackling the lack of knowledge in both primary and secondary care inhaler application, a series of communication measures were put in place to make sure HCPs and all patients receive improved and consistent training for MDI and other inhaler applications. - Training the trainers: HCPs were initially instructed on how to use the inhalers themselves, and then trained to measure a patient's ability to use their prescribed inhaler, rather than the previous less scientific visual assessment. - Equipping patients: Once properly instructed and able to use their inhaler efficiently, patients were also issued with a training aid for regular use post contact with the HCP in order to avoid slipping back into previous bad habits. This was the first time such aids have been available free of charge from the NHS. - Patient communication: An advertising campaign was run to advise patients of the new training on offer via their HCP and invite them to be re-trained. - Holistic working: A more collaborative relationship has been implemented with both primary and secondary care practitioners working closely together, including GPs formally referring patients to their community pharmacist for inhaler technique training. The training aid carried a cost but this was paid back 7-times over with the reduction in cost of bronchodilators within year 1 of the project.

Results and Evaluation: According to Asthma UK, the Isle of Wight standardised admission rates (SAR) for asthma are the lowest in the UK, with an SAR of 52 in 2008/9, having not been listed in the top 23 PCTs in England in the previous report (standardised where 100 would be mean). (Asthma UK figures, released 2009 based on full Hospital Episode Statistics dataset for England). Reliever therapy (measured by ePACT) showed an immediate drop, and within the first year costs of selective beta-agonists fell by 22.7% - a saving greater than 7 times the initial investment by the PCT. (measured as NIC/STAR PU - net ingredient cost per specific therapeutic group age-sex prescribing unit) and a decrease against trend of 25.2% in prescription numbers. Additionally, within 12 months, the Isle of Wight PCT was able to demonstrate through validated hospital data, and Hospital Episode Statistics that emergency admissions due to asthma had reduced by 50%, and deaths by 75%. Prescribing of selective beta-agonists is still falling, taking the PCT spend for

bronchodilators to approximately 20% below the national average for this class of drugs. It is pleasing to note that use of ICS preventers, when compared with the trend for England, is also decreasing. Hospital inpatient costs for asthma-related admissions have fallen by 66% since the project commenced. (figures from www.hesonline.nhs.uk) South East Public Health Observatory (May 2009) have quoted IOW COPD admissions data as exceptionally good despite high prevalence and advise other PCTs to copy the IOW. Local Pharmaceutical Committee have evaluated public and HCP opinion - highly supportive.

<http://www.nice.org.uk/usingguidance/sharedlearningimplementingniceguidance/examplesofimplementation/eximpresults.jsp?o=461>

194. Inhaler device technique cards - seven steps to success...

University Hospitals of Leicester NHS Trust website, 2012

Inhaled delivery of drugs is essential for the management of many respiratory conditions, including chronic obstructive pulmonary disease (COPD) and asthma. Correct use of the inhalation devices is essential to ensure the beneficial effects of therapy, while minimising potential adverse effects. Inhaler technique assessment and training needs to be delivered at the initiation of therapy with a new inhaler device, but also needs to be repeated throughout the period that the patient received inhaled drug therapy. A recent review suggested that up to 25% of patients have not received any verbal instruction for the use of their prescribed inhaler. Inhaler technique is repeatedly recognised to be poor in a significant number of patients. Errors in inhaler technique are associated with suboptimal delivery of the drug into the lungs and may also potentially increase the risk of adverse effects, particularly those associated with the mouth and throat. In one study of 4078 adults with asthma treated with inhaled corticosteroids delivered by a metered dose inhaler (MDI), poor technique was identified in 71% of patients. Asthma control was found to be worse in patients with poorer inhaler technique, than patients with good inhaler technique.

Inhaler technique training needs to be undertaken by a health care professional proficient in providing inhaler technique demonstration to the patient. There is evidence that the training is not always delivered by appropriately trained staff. It should not be simply assumed that all healthcare professionals have perfect inhaler technique.

A number of studies have identified that a variety of healthcare professionals often have poor knowledge on the optimal use of different inhaler devices. Regular ongoing education of health care professionals is likely to be of paramount importance to ensure that they are able to adequately teach patients inhaler technique.

The 7-Steps to Success Inhaler Reminder Cards are an easy-to-use and highly portable reference source to help remind healthcare professionals on how to use each different type of inhaler device. They are designed to support the correct instruction of inhaler device technique during patient consultations. To simplify the process each inhaler device has 7 steps to achieving optimal technique.

<http://www.leicestershospitals.nhs.uk/professionals/educational-products-and-tools/inhaler-device-cards/>