Inhaler devices for asthma: do we follow the guidelines?

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Background: Despite national guidelines for asthma treatment, many children have troublesome symptoms.

Aim: To assess the extent to which the use of inappropriate inhaler devices contributes to this problem.

Methods: Of 14 813 questionnaires distributed to schoolchildren, 6996 (47%) were returned identifying 1444 children using asthma inhalers. Inhalers were categorised as age appropriate or inappropriate according to national guidelines and were compared with those used by 75 patients attending a hospital clinic.

Results: A total of 35% of "schools" and 4% of "clinic" children reported using an inappropriate inhaler device. Most were using metered dose inhalers alone. Twenty four per cent of "schools" children ≤ 5 years old did not use a spacer. Both children and parents overestimated the child's ability to use their inhaler.

Conclusions: Large numbers of children are given inhalers they cannot use. To improve asthma care we must ensure that prescriptions reflect the age and ability of the child. Recent recommendations by the Department of Health in England and Wales stress the importance of seamless care between primary and secondary services. As the management of childhood asthma is guided primarily by secondary care providers, it is therefore imperative that general paediatricians know the difficulties and issues which are occurring in the community. This will enable them to lead and support necessary change.

Effective treatment is available for most children with asthma.¹ However, many still suffer from frequent symptoms which interfere with their lives and cause distress to them and to their families.^{2–4} A recent large survey shows a significant gap between the long term goals of asthma therapy and reality in Western Europe.⁴ The authors suggest this is largely a result of low patient expectations, insufficient monitoring by health professionals, and the underutilisation of inhaled corticosteroids. However, neither the original paper nor the associated editorial⁵ acknowledge that persistent symptoms may be a result of the prescribing of inappropriate inhalers and/or inadequate inhaler technique.

Difficulties with inhaler technique are well recognised in children.^{1–7} The British guidelines for asthma management stress that specific inhaler devices should be used in different age groups of children (table 1).^{8–9} As children will only benefit from treatment if they are given an inhaler they can use, the selection of an appropriate inhaler device is as important as choosing the right medication.¹

A recent asthma health promotion day suggested that problems with inhaler technique may be significantly contributing to the persistence of asthma symptoms in children in Stoke-on-Trent. During a single day in a local shopping centre, 568 people approached us with questions about asthma management. Many complained their children had persistent

symptoms and had difficulty using their inhalers. Many were using devices inappropriate for their age. Therefore, the aim of this study was to establish whether the use of inappropriate inhalers was widespread in children.

MATERIALS AND METHODS

As part of a recruitment drive for an asthma genetics study, all 245 head teachers in Stoke-on-Trent were asked whether they would distribute a questionnaire to all the pupils in their school; 119 agreed, four refused, and 122 failed to reply. Questionnaires were distributed to 43 schools selected as representative of the local population. Special schools were excluded.

The questionnaire comprised 10 questions, seven to identify children suitable for recruitment into the genetics study and three to assess inhaler use. Parents were asked to state the age of any child with asthma and to identify the child's current treatment by ticking one or more of five boxes: (1) Ventolin, salbutamol, Bricanyl, or any other blue inhaler; (2) Becotide, Beclazone, or beclomethasone; (3) Pulmicort or budesonide; (4) Flixotide or fluticasone; (5) Intal or sodium cromoglycate. They were also asked to identify the child's inhaler device by marking one of eight diagrams: metered dose inhaler; Spacer, Volumatic or Nebuhaler; Easibreathe or Autohaler; Diskhaler; Turbohaler; Accuhaler; Spinhaler; or Rotahaler. They were free

Table 1 Inhaler devices recommended in national guidelines (British Thoracic Society, 1993)

Children aged 0–5 years	(1) Metered dose inhaler with spacer (+ facemask if age <2 years) (2) Nebulised therapy if 1 fails
Children aged 5–8 years	(1) Metered dose inhaler + spacer (2) Dry powder inhaler
Children older than 8 years	(1) Dry powder inhaler (2) Metered dose inhaler with spacer (3) Breath actuated device

Table 2 Categorisation of inhaler devices used in the analysis

Age 0–5 years	1st choice	Metered dose inhaler with spacer
	2nd choice	Nebuliser
	Inappropriate	Any other device
Age 6–8 years	1st choice	Metered dose inhaler with spacer
	2nd choice	Dry powder inhaler
	Inappropriate	Any other device
Age >8 years	1st choice	Dry powder inhaler or metered dose inhaler with spacer
	2nd choice	Breath actuated device
	Inappropriate	Any other device

Table 3 School population

School type	Total number of schools	Agreed to distribute	Selected to distribute	School returned questionnaires	Total questionnaires distributed	Total questionnaires completed and returned
State						
Primary/junior	200	93	29	25	6338	3130 (49%)
Middle	4	2	2	2	1135	705 (62%)
Secondary	33	21	10	8	5965	2469 (41%)
Private						
Primary/junior	4	2	1	1	125	85 (68%)
Middle	1	0	0	–	–	–
Secondary	3	1	1	1	1250	577 (46%)
Total	245	119	43	37	14813	6966 (47%)

to mark as many inhalers as they wished and were asked to provide data for all “children” with asthma aged between 4 and 35 years (the age range needed for the genetics study). The data presented are from “children” aged ≤16 years.

Inhalers were subsequently categorised as: metered dose inhaler alone; metered dose inhaler and spacer (Spacer); dry powder inhaler (Diskhaler, Accuhaler, Turbohaler, Spinhaler, Rotahaler); or breath actuated device (Easibreathe, Autohaler). Based on the British guidelines for asthma management, the devices were further categorised to be appropriate or inappropriate for the age of the child (table 2).

The accuracy of the schools questionnaire was assessed in a subgroup of 73 children; their parents were interviewed in depth about their asthma therapy as part of the genetics study. The interviewers were blinded to the responses in the schools questionnaire.

Information about inhaler technique was obtained from 77 children attending the paediatric outpatient clinic. These children did not complete the schools questionnaire. They and their parents were asked whether they felt they were able to use their inhaler properly. The child's technique was checked for all the inhalers they were using and was categorised to be adequate or otherwise by a specialist asthma nurse.

Table 4 Age distribution of population in whom inhaler device and age data were available

Age (y)	Number of individuals		Total number
	School	Clinic	
0–5	184	20	204
6–8	310	17	327
9–12	550	21	571
13–16	400	17	417
Total	1444	75	1519

Duplication of data was avoided by cross referencing the questionnaires and the clinic data. The study was approved by the local research ethics committee.

RESULTS

Schools questionnaire

Questionnaires were distributed to 43 schools (table 3); six failed to distribute or collect the questionnaires. Questionnaires were distributed between July 1999 and September 2000 to a total of 14 813 children, representing 20% of the 72 000 schoolchildren in Stoke-on-Trent.¹⁰ A total of 6966 (47%) questionnaires were completed and returned. From these, 1656 subjects with asthma were identified. Age data were available for 1623 subjects: 1464 aged ≤16 years (children) and 159 aged >16 years (adults).

Use of inhaler devices

Information about the use of inhaler devices was obtained from 1519 children: 1444 from the schools questionnaire and 75 from the outpatient clinic (table 4). The clinic children were slightly younger than those from the schools (mean age (SD) 8.5 (4.2) years v 10.0 (3.4) years, $p < 0.01$). Ninety six per cent (72/75) of the clinic children were using inhalers appropriate for their age (91% first choice device, 5% second choice device) compared with only 65% (943/1444) from the schools (53% first choice device, 12% second choice device) ($\chi^2_1 = 30.3$, $p < 0.001$).

More “schools” than clinic children used a metered dose inhaler alone (35% schools v 7% clinic; $\chi^2_1 = 32.9$, $p < 0.001$). This finding remained significant after stratification by age. In the “schools” children, 44/184 (24%) aged ≤5 years, 75/310 (24%) 6–8 years, 206/550 (37%) 9–12 years, and 205/400 (51%) 13–16 years were treated with a metered dose inhaler alone. This compared with 1/20 (5%) ≤5 years, 1/17 (6%) 6–8 years, 1/21 (5%) 9–12 years, and 2 (12%) 13–16 years in the clinic group. Of those using metered dose inhalers alone, none of the clinic children and 40% (33% ≤5 years, 58% 6–8 years,

Table 5 Inhaler technique assessed by specialist nurse in paediatric clinic

Age (y)	No. children tested	Device	Technique	
			Good	Poor
0–5	20	Metered dose inhaler and spacer	17	3
	0	Dry powder inhaler	–	–
	0	Breath actuated device	–	–
	1	Metered dose inhaler alone	–	1
6–8	13	Metered dose inhaler and spacer	11	2
	4	Dry powder inhaler	2	2
	4	Breath actuated device	3	1
	1	Metered dose inhaler alone	–	1
9–16	19	Metered dose inhaler and spacer	14	5
	24	Dry powder inhaler	24	–
	6	Breath actuated device	5	1
	3	Metered dose inhaler alone	3	–

27% 9–12 years, 51% 13–16 years) of the “schools” children used these to deliver corticosteroids. Below 5 years of age, spacers were used in all children who attended the clinic but in only 76% of the schools population ($p = 0.014$). Dry powder inhalers were very rarely used in children younger than 5 years (only five “schools” children). Above 5 years significantly more clinic children used them (51% *v* 25%, $p < 0.001$). In this age group only 56% of the clinic children and 31% of “schools” children reported access to a spacer ($p < 0.001$). Nebulised or oral therapy was very rarely used in the schools population (4 (0.27%) and 12 (0.78%) respectively) and not at all in the clinic. All four children using nebulised therapy were over 8 years old. After excluding spacer usage, 12% of the schools population and 8% of the clinic population reported using more than one type of inhaler device.

Use of asthma medication

Ninety eight per cent of children (1402/1434) reported using a short acting bronchodilator; 582 (41%) of these took no other treatment. Of the 59% (848/1434) using preventive therapy, 32 (4%) had no access to a short acting bronchodilator. There was no significant difference in the number of children using inhaled steroids above and below the age of 5 years (59% *v* 53%, $p = 0.16$). Two per cent of those using preventive therapy described using more than one inhaled steroid. Additional therapy with salmeterol ($n = 22$), montelukast ($n = 1$), theophylline ($n = 3$), oral prednisolone ($n = 5$), or ipratropium bromide ($n = 4$) was reported in 32 children (2.2%). Four of these were not using any preventive therapy and four were using more than one additional therapy. Three children were using alternative therapies (regular steam, herbal remedies, acupuncture). Information about asthma medication was not collected in the clinic population; all data are for the 1434 children who answered this section of the schools questionnaire.

Ability to use inhaler devices

Inhaler technique was assessed in 75 children in the outpatient clinic. Nineteen were tested using two devices, and one using three devices, giving a total of 96 test results (table 5). The number of tests in which children (89/90, 99%) or parents (93/96, 97%) believed the inhalers were being used correctly differed significantly from the number (79/95, 83%) where technique was thought to be adequate by the specialist nurse (nurse *v* child: McNemar's $\chi^2_1 = 11.27$, $p < 0.001$; nurse *v* parent: McNemar's $\chi^2_1 = 13.00$, $p < 0.001$). The differences remained significant when data were analysed using only one randomly selected inhaler device for each child. There was no significant difference between the mean ages (SD) of the children with adequate and inadequate inhaler technique (9.1

(4.2) *v* 8.1 (3.6) years, $p > 0.1$). At least 10 of the 14 children with poor inhaler technique had been seen previously in the paediatric respiratory clinic. The three children with good inhaler technique using a metered dose inhaler alone were aged 8, 14, and 15 years.

Validity of responses to schools questionnaire

Seventy three children completed both the schools questionnaire and the genetics of asthma interview. In 47 (65%) the information obtained was identical. In a further 11 (15%) the same medication and inhaler devices were identified but a parent identified an additional inhaler device (8/11 spacer) on the schools questionnaire. Three (4%) children were no longer taking treatment by the time of their interview. A further eight (11%) mentioned a different device, three (4%) a different medication, and one (1%) both a different medication and a different device.

DISCUSSION

National guidelines for the management of asthma have been available in the UK for over seven years.^{8,9} Emphasis is placed on choosing an inhaler appropriate for the patient. Clear guidance on inhaler usage in both adults and children is available from many sources.^{8,9,11,12} Recently, the National Institute for Clinical Excellence has also made recommendations about inhaler devices for the preschool child.¹³

The results of this study are not encouraging. Over one third of children with asthma answering the schools questionnaire had been prescribed an inhaler that was almost certainly unsuitable for their use. Most of these had been prescribed a metered dose inhaler alone. Seventeen per cent of children ≤ 5 years and two thirds > 5 years who were prescribed a metered dose inhaler did not record using a spacer. Some may have simply forgotten to mention it but our results suggest that families were more likely to mention a spacer on the questionnaire than they were during an interview. This may be because one of the schools questions was specifically designed, in diagram form, to remind them of the possibility of a spacer. The use of inhalers in the paediatric clinic was more appropriate, with 96% using a suitable device. However, although spacers were prescribed for all children < 5 years, one did not use her's regularly. Spacers were under-represented in children > 5 years old.

Our study can be criticised because we cannot be certain that the results are representative of the population. Of 245 schools approached, only 119 (49%) agreed and only 43 (18%) were selected. The return rate for the questionnaire was 47% and only 80% of the responses can be assumed to be similar to those which would have been obtained during an interview.

Nevertheless, this large observational study provides us with information about inhaler use in nearly 1500 children with asthma. The schools which returned questionnaires were representative of the Stoke-on-Trent population in terms of location, pupil age, and school type. We cannot be sure that children from non-participating schools were similar to those participating in terms of asthma therapy but there is no reason to believe this is not the case. It is possible that children who had poorly controlled asthma returned their questionnaires more frequently than those who did not, thus potentially inflating the number of children using inappropriate inhalers in percentage terms. However, even if this were true, this study shows that 501 children with asthma reported using an inhaler inappropriate for their age. Assuming a similar response rate from the non-participating schools, this suggests that up to 2500 schoolchildren in Stoke-on-Trent may be using an inhaler not recommended by the national asthma management guidelines.

New asthma guidelines are being developed on evidence based principles. These may affect prescribing but experience does not support this. Pearson *et al* have shown poor adherence to national guidelines,¹⁴ and a recent study has shown the difficulties of using research findings to improve clinical management.¹⁵ However, the evidence in the literature is clear. Only 50% of well trained adults can use a metered dose inhaler appropriately¹⁶ and children, in general, cannot. Even with optimal technique, metered dose inhalers give poor deposition of medication within the bronchi.¹⁷ With inhaled corticosteroids, high oral deposition can lead to local and systemic side effects.¹⁷ It is therefore rarely justifiable to prescribe metered dose inhalers alone to children of any age.⁹ A metered dose inhaler used with a large volume spacer requires less coordination than a metered dose inhaler alone.¹⁷ Spacers increase the proportion of the medication reaching the airways and reduce oropharyngeal deposition.¹⁷ They have also been shown to be at least as effective as nebulisers in the treatment of acute exacerbations.^{11 18 19} Breath actuated and dry powder inhalers also require less coordination than metered dose inhalers, but may be inadequate during severe exacerbations, when even older children and adults may have difficulty in generating an adequate inspiratory flow.^{18 20} For these reasons, all patients <5 years old and all those needing high dose inhaled corticosteroids should use a spacer regularly,¹⁷ and all children with asthma should have access to a spacer for use in emergencies. Inhaler techniques need to be demonstrated to the child during the first consultation and reinforced repeatedly at each clinic visit.²¹ This applies equally to secondary care where inhaler technique is still undervalued and undertaught (Paton and Lenney. National audit of hospital management of acute severe asthma; a minimum data set (paediatrics) 1998–2000. Unpublished data).

The burden of asthma on children, families, and the Health Service is immense.²² More careful attention to the choice of inhaler devices is mandatory to ensure that medications known to be effective in the laboratory actually reach the airways of children with asthma. Our study suggests that guidelines alone are not sufficient to achieve this. Unlike other diseases, management of childhood asthma is primarily driven by recommendations from secondary care; over recent years there have been strong recommendations that asthma groups comprising secondary and primary care physicians should be formed in each district.^{23 24} In Stoke, we believed that we had such a group which had been working for years to try to improve asthma care in both adults and children. We now realise that, in relation to inhaler use, this has failed. Recent recommendations from the Department of Health stress the

importance of seamless care between primary and secondary services. It is therefore imperative that general paediatricians know the difficulties and issues which are occurring in the community. This will enable them to lead and support necessary change. Fortunately links between primary and secondary care in Stoke and Staffordshire are good, and the recent development of health action zone projects and respiratory care pathways by primary care groups gives us an ideal opportunity to educate health professionals and do better in the future. Continued involvement of local and national patient groups will also be necessary to ensure the message reaches the children who need it.

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