



## Comparison of a New Multidose Powder Inhaler (Diskus<sup>®</sup>/Accuhaler<sup>®</sup>) and the Turbuhaler<sup>®</sup> Regarding Preference and Ease of Use

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To cite this article: Job van der Palen, Jakob J. Klein & Angelique M. Schildkamp (1998) Comparison of a New Multidose Powder Inhaler (Diskus<sup>®</sup>/Accuhaler<sup>®</sup>) and the Turbuhaler<sup>®</sup> Regarding Preference and Ease of Use, *Journal of Asthma*, 35:2, 147-152, DOI: [10.3109/02770909809068202](https://doi.org/10.3109/02770909809068202)

To link to this article: <http://dx.doi.org/10.3109/02770909809068202>



Published online: 02 Jul 2009.



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# Comparison of a New Multidose Powder Inhaler (Diskus<sup>®</sup>/Accuhaler<sup>®</sup>) and the Turbuhaler<sup>®</sup> Regarding Preference and Ease of Use

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### ABSTRACT

Many patients with asthma or chronic obstructive pulmonary disease (COPD) use their inhaler ineffectively. Several studies revealed that inhaler-specific design features contributed significantly to the failure rate, which clearly demonstrates the need for developing more "foolproof" inhalers. This study compared ease of use and patient preference of the Diskus<sup>®</sup>/Accuhaler<sup>®</sup> (DA) with the Turbuhaler<sup>®</sup> (TH). Fifty patients with asthma or COPD aged 15 years and older were included in a randomized, crossover comparison of DA with TH regarding patient preference and ease of use. All had to be naïve to DA and TH, but currently had to be using inhaled medication with another device. Inhalation technique was assessed using inhaler-specific checklists and patients had to state a preference for DA or TH regarding various aspects, as well as overall preference. With DA 46 patients (92%) made no errors regarding essential inhalation maneuvers, compared to 37 patients (74%) using TH ( $p = 0.023$ ). This difference is exclusively caused by not loading the TH properly. When patients were asked which inhaler they would prefer, 17 wanted the DA, 25 the TH, and 8 did not state a preference. The difference was not significant. TH was favored over DA regarding factors related to size and the number of avail-

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able dosages. The counting mechanism of the DA was preferred over the TH. It seems that patients have a clear, although not statistically significant, preference for TH, but with the DA fewer patients make crucial errors.

## BACKGROUND

Inhaled medication plays an important role in the treatment of asthma and chronic obstructive pulmonary disease (COPD), but up to 85% of patients use their inhaler ineffectively (1–8). Several studies revealed that inhaler-specific design features contributed significantly to the failure rate (9–12). This clearly demonstrates the need for developing more “foolproof” inhalers, as the efficacy of inhaled medication depends largely on inhalation technique. Recently a new multidose powder inhaler (Diskus<sup>®</sup>/Accuhaler<sup>®</sup>, Glaxo Wellcome, UK) has been developed. Its acceptability and ease of handling in patients already using other powder inhalers or metered-dose inhalers (MDIs) have yet to be established. This study compared handling of the Diskus<sup>®</sup>/Accuhaler<sup>®</sup> (DA) with another widely used multidose powder inhaler, the Turbuhaler<sup>®</sup> (TH, Astra, Sweden). Furthermore, patients' preferences regarding various aspects of the inhalers were looked at.



Figure 1. Diskus<sup>®</sup>/Accuhaler<sup>®</sup>.

## METHODS

Approval for the study was first acquired from the hospital's Ethics Committee, after which informed consent was obtained from 50 patients with asthma or COPD, who attended the pulmonary outpatient department between June 1995 and March 1996. Only patients 15 years and older, who were naïve to DA and TH, but were currently using inhaled medication, were included in the study. Patients with a limited ability to understand and speak Dutch were excluded.

Patient variables, medication use, as well as acceptability and ease of use of both DA and TH, were assessed by one well-trained pulmonary-function technician in an open, randomized, crossover study.

First, patients were shown TH or DA in a randomized order. They were asked to read the inhaler-specific instruction leaflet and subsequently use the new inhaler. Inhalation technique was assessed using a purpose-designed, inhaler-specific checklist (Table 1). The same



Figure 2. Turbuhaler<sup>®</sup>.

procedure was repeated for the second inhaler. Some checklist items, such as "exhale to residual volume" and "hold breath for 5 sec," were common for both inhalers, while others were device-specific. For both inhalers items were identified that were essential for optimal drug delivery into the lungs (Table 1). When errors are made regarding these key actions, it is likely that no or only an insignificant amount of medicine will be inhaled.

Second, patients were asked to indicate on a five-point scale the importance they attributed to a number of features of the inhaler (Table 2). Finally, they had to state a preference for DA or TH regarding the various features, and overall preference was asked for.

### Statistical Analysis

Four aspects of inhalation technique were evaluated:

1. The percentage of patients correctly demonstrating each individual item on the check-

list was calculated for both inhalers (Table 1), and a *mean score* for both inhalers, based on *all checklist items* was calculated by dividing the number of items correctly performed by the total number of items on the checklist. The result was expressed as a percentage.

2. A *mean score*, based on subgroup of selected "essential" checklist items only, was calculated in a similar manner.
3. Another analysis was based on the *percentage* of patients performing *all items correctly*.
4. Another analysis was based on the *percentage* of patients performing *all essential items correctly*.

Differences in mean scores between the two inhalers, and also a possible period effect, after verifying that there were no carry-over effects, were tested by means of *t*-tests as appropriate for crossover studies (13). Ninety-five percent confidence intervals (95%CI) are presented. Differences in the proportions of patients with a perfect score on essential items were compared with McNemar's test. The difference in the percentage of patients expressing a preference for DA or TH was assessed by the binomial test. The limit of statistical significance was set at  $p = 0.05$  (two-sided). Analyses were performed using the statistical package SPSS (14).

## RESULTS

Fifty patients (mean age 49 years, SD 17, range 15–74) were included (29 had asthma, 21 COPD) who had been using inhaled medication for an average of 5.6 years (SD 4.2, range 1–17). Forty patients (80%) had previously received instruction in inhalation technique, on average 3.2 years ago (SD 1.9; range 1–7). Rotahaler<sup>®</sup> was used by 21 patients, Diskhaler<sup>®</sup> by 20, MDIs by 16, and Inhaler Ingelheim<sup>®</sup> by 8 patients, implicating multiple inhaler use.

### Inhalation Technique

#### ALL CHECKLIST ITEMS, MEAN SCORES

The individual checklist-item scores varied from 60% of patients exhaling to residual vol-

**Table 1.** Inhaler-Specific Checklists with Item Scores

	ITEM SCORE <sup>a</sup>
Diskus checklist	
1. Open inhaler <sup>b</sup>	100
2. Push lever back completely <sup>b</sup>	92
3. Exhale to residual volume	60
4. Exhale away from mouthpiece	98
5. Mouthpiece between teeth and lips	100
6. Inhale forcefully and deeply <sup>b</sup>	100
7. Hold breath for 5 sec	94
8. Exhale away from mouthpiece	98
9. Close inhaler	92
Turbuhaler checklist	
1. Remove cap from inhaler <sup>b</sup>	100
2. Keep inhaler upright <sup>b</sup>	88
3. Rotate grip until "click" <sup>b</sup>	86
4. Exhale to residual volume	62
5. Exhale away from mouthpiece	94
6. Mouthpiece between teeth and lips	100
7. Inhale forcefully and deeply <sup>b</sup>	100
8. Hold breath for 5 sec	94
9. Exhale away from mouthpiece	98
10. Replace cap	98

<sup>a</sup>Percentage of patients performing the checklist item correctly.

<sup>b</sup>Essential checklist item.

ume, prior to inhaling, to 100% of patients correctly "opening" the inhaler, placing it correctly in the mouth, and subsequently inhaling forcefully and deeply (Table 1). The difference in mean checklist scores for DA (92.7%) and TH (92.0%) was not significant ( $p = 0.52$ ; 95%CI for difference—1.41–2.74).

There was no evidence for significant period effects, as in all following analyses.

#### ESSENTIAL CHECKLIST ITEMS ONLY, MEAN SCORES

Errors regarding essential checklist items only pertain to maneuvers associated with "loading" the device (Table 1). With the DA less errors in "loading" were made than with the TH, resulting in a higher mean checklist score (97.3% and 93.5%, respectively) ( $p = 0.045$ ; 95%CI for difference 0.09–7.58).

#### PERCENTAGE OF PATIENTS PERFORMING ALL ITEMS CORRECTLY

With the DA 25 patients (50%) made no errors at all, compared to 23 patients (46%) using the TH. The difference was not significant ( $p = 0.75$ ).

#### PERCENTAGE OF PATIENTS PERFORMING ALL ESSENTIAL ITEMS CORRECTLY

With the DA 46 patients (92%) made no errors regarding essential items, compared to 37 patients (74%) using the TH. This difference was statistically significant ( $p = 0.023$ ).

### Importance

Ninety-eight percent of patients considered a clear instruction leaflet to be important or very important. Of the specific inhaler aspects more than 90% found ease of holding the device, overall perceived ease of use, ease of use in acute exacerbation, and a clear counting mechanism important (Table 2).

### Preferences

When patients were asked which inhaler they would prefer if their doctor was to prescribe a new inhaler, 17 wanted the DA, 25 the TH, and 8 did not state a preference. The difference was not statistically significant (Table 2).

With regard to various aspects of the inhalers, TH was favored over DA regarding ease of carrying, size, inconspicuousness, and the number of available dosages (200 for TH versus 60 for DA). Inconspicuousness was not considered important by 62% of patients. The counting mechanism of the DA (indicating numerically the number of dosages remaining) was preferred over the TH (an indicator when 20 dosages remain). None of the other aspects showed significant differences between DA and TH. This was also true for "overall perceived ease of use" and "ease of use during an exacerbation."

## DISCUSSION

This study showed that inhalation technique with DA and TH was equally good when all checklist items were considered, but a small, statistically significant difference in mean scores, pertaining to essential items only, was found. The difference in the number of patients making no errors regarding key maneuvers (92% for DA vs. 74% for TH) is both statistically and clinically significant. This difference is exclusively caused by not loading the device properly. Loading the DA requires only one correct action, namely pushing the lever back; this was forgotten by 4 patients, which resulted in a complete failure to inhale any medicine. Loading the TH involves two critical steps. The TH grip should be rotated forward and backward, while holding it at an angle of less than 45 degrees from the vertical. Seven patients did not rotate the grip, and thus did not load the inhaler, and 6 patients failed to hold the TH approximately vertical while rotating the grip, which would have resulted in a decreased amount of medicine available for inhalation. The different aspect of loading makes the DA more foolproof than the TH.

Two other studies (15, 16) compared inhalation technique of DA and TH among MDI users only. They found the main difficulties to be opening the DA (14 and 7%, respectively), and sliding the lever back [9% in the study by Sharma et al. (16)]. In our study we encountered no problems with opening the DA but we also found that 8% of patients did not slide the lever

back. For the TH the observed problems by Schlaeppi et al. and Sharma et al., were twisting the grip forward (21 and 16%, respectively) or backward (14 and 10%, respectively). Sharma et al. also noted that 11% did not hold the TH upright while loading the device. These problems with the TH were confirmed by our own results. Their patients seemed to handle the inhalers slightly better than ours. They found that 75 and 77% of patients handled the DA correctly, and 64 and 70% did so with the TH. This compares favorably with our population where only 50 and 46% were able to use DA and TH without any errors. However, the authors do not provide the checklists they used, so a valid comparison is not possible. Furthermore, their patients were MDI users only, while our population used both MDIs and powder inhalers.

When overall preference was assessed, slightly more patients preferred the TH over the DA (50% and 34%, respectively), and 16% did not state a preference, but this was not statistically significant. Seven patients (14%) explicitly stated, that their preference for the TH was due to the higher amount of available

dosages (200 for TH vs. 60 for DA). Furthermore, the TH scored better in aspects related to its size. The counting mechanism of the DA was preferred over the indicator window of the TH, but for only 1 patient was this a reason to state an overall preference for the DA. In the study by Schlaeppi et al. (15), 65% and 35% of the patients preferred the DA and the TH, respectively. The study by Sharma et al. (16) only mentions an overall statistically significant preference for the DA, but gives no actual numbers. One explanation of this different finding could be that patients were told that the TH contained 200 doses, and that this was approximately 1 month's therapy. When a typical patient would be prescribed a daily dose of 800 µg of e.g., budesonide (two inhalations per day) the TH would contain enough medicine for 3 months, compared to 1 month for the DA when two inhalations per day (total daily dose of 500 µg of fluticasone propionate) would be prescribed. In our study 70% of the patients preferred the TH over the DA with regard to the number of available dosages. Given the relative importance of this item (86% found this an

**Table 2.** Patient Preference of Various Aspects of the Inhalers, Ranked in Order of Importance

ASPECT OF THE INHALERS	ITEM IMPORTANCE <sup>a</sup>	PREFERENCE <sup>b</sup> FOR		NO PREFERENCE	p-VALUE <sup>c</sup>
		DISKUS	TURBUHALER		
Instruction leaflet	98	14	7	29	0.189
Ease of holding the device	96	14	21	15	0.311
Overall perceived ease of use	96	14	19	17	0.486
Ease of use in acute exacerbation	94	14	19	17	0.486
Counting mechanism	92	27	8	15	0.002
Ability to use medicine quickly	88	11	19	20	0.201
Large amount of dosages	86	6	35	9	<0.001
Ease of use of cap	86	12	24	14	0.067
Hygiene of the device	86	10	10	30	1.000
Shape of mouthpiece	84	13	17	20	0.584
Susceptibility to moisture	84	13	11	26	0.839
Ease of carrying around	82	9	32	9	<0.001
Size	76	6	36	8	<0.001
Weight	70	16	12	22	0.571
Tasting the medicine	60	13	21	16	0.230
Overall attractiveness	50	21	20	9	1.000
Inconspicuousness	38	10	23	17	0.037
Overall preference		17	25	8	0.280

<sup>a</sup>Percentage of patients designating item as important or very important.

<sup>b</sup>Number of patients expressing a preference for Diskus, Turbuhaler, or none.

<sup>c</sup>Binomial test for comparing preferences between devices.

important aspect of an inhaler), and the strong preference, this could partly explain the observed difference in overall device preference between the studies of Schlaeppi et al. and Sharma et al., on the one hand, and our study, on the other hand. Therefore, in the assessment of inhaler preference, the amount of available dosages should be included.

In summary, patients do not seem to have a preference for DA or TH, but with the DA fewer patients make crucial errors.

### ACKNOWLEDGMENT

This research has been sponsored by Glaxo Wellcome.

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