

**Assessment of real-world patient inhalation techniques with a Metered Dose Inhaler and Smart Spacer:
Which errors are observed and can these be addressed through tailored education?**

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Summary

Although inhalers have been on the market for more than 50 years and the technology associated with the devices themselves has evolved, they are still often used incorrectly. In recent years, a few different ‘smart’ inhalers have been developed with the aim of improving patient adherence to therapy, including improving inhaler technique. One prototype device currently being investigated clinically is a Smart Spacer (valved holding chamber). Patient inhaler technique assessments when using the Smart Spacer (with MDI) in an adult asthma study were performed with the objective of understanding general variability of some standard technique metrics as well as subsequent observations following feedback from HCPs. Peak inhalation flow rate, inhaled volume, and delay time between MDI actuation and inhalation were analysed from 29 patients over two consecutive 1 month periods, with a training visit in-between. Fifteen patients had standard technique training and 14 patients had tailored training based upon feedback from the first 1 month data. Many patients had average peak inhalation flow rates that were higher than ideal during the first month (14 out of the 29 patients were above 100 l/min). This technique error was corrected in a larger number of patients in the intervention group, where the training at the 1 month visit focused on this specific aspect of technique. Inhaled volume was only low in two patients and this was corrected after they received their tailored training. Inhalation delay times were satisfactory for all patients. This study was able to provide real-life insights into adult asthmatic inhalation techniques and demonstrated the ability of the Smart Spacer to highlight specific errors, thus enabling the HCP to focus and tailor their consultation time on the key areas with subsequent improvements in technique observed.

Key Message

This study demonstrated the ability of a Smart Spacer to highlight specific inhalation technique errors, thus enabling the HCP to focus and tailor their valuable consultation time on the key areas with subsequent improvements in technique observed.

Introduction

Although inhalers (including metered dose inhalers (MDIs), dry powder inhalers and soft mist inhalers) have been on the market for more than 50 years and the technology associated with the devices themselves has evolved, they are still often used incorrectly. A systematic review looking at patients’ inhaler technique from the 1960s to 2014 reported that on average only 30% of patients had good technique, with little or no change over time [1]. A separate systematic review looking at health care professional (HCP) awareness of inhaler technique reported that only 15% understood good technique correctly [2]. In recent years, a few different ‘Smart’ inhalers have been developed with the aim of improving patient adherence to therapy, including improving inhaler technique [3,4,5]. One prototype device currently being investigated clinically is a Smart Spacer (valved holding chamber), Fig.1 Smart AeroChamber* VHC, which can identify the MDI being used (controller or reliever), monitor adherence to dosing regimen and monitor inhaler technique.

The existence of such devices and use of them in clinical studies enables assessment of real-world patient inhaler techniques, such information gathered in a non-supervised and therefore more realistic environment. This paper reports patient inhaler technique assessments when using an MDI with Spacer for an adult asthma study [6] performed in the Netherlands with the objective of understanding general

variability of some standard technique metrics as well as subsequent observations following feedback and additional training from HCPs.



Figure 1 – Prototype Smart Spacer

Methods

The clinical study was performed in a primary care setting in the Netherlands, with data analysed from 29 adult asthma patients. All patients were provided standard inhaler training prior to 1 month use of their MDIs with Smart Spacer. 15 patients in the control group then had a meeting with their HCP and were given standard training again followed by a further 1 month Smart Spacer use. 14 patients in the intervention group followed a similar pathway, except that the 1 month HCP meeting included customized training based upon review of the technique data from the first month (so focus placed on highlighting any specific technique errors).

Spacer technique data was evaluated with respect to the following metrics:

- Peak inhalation flow rate (anything above 70 L/min flagged as a warning for being too high)
- Inhaled volume (anything below 450ml flagged as a warning for being too low)
- Delay between MDI actuation and patient inhalation (anything above 5 seconds flagged as being too long)

Data analysis of these metrics was performed comparing the first and second months of treatment for both the control and intervention groups, for each of the three technique metrics.

Results

Figures 2 to 7 below show the results for the three different MDI / Spacer technique metrics assessed.

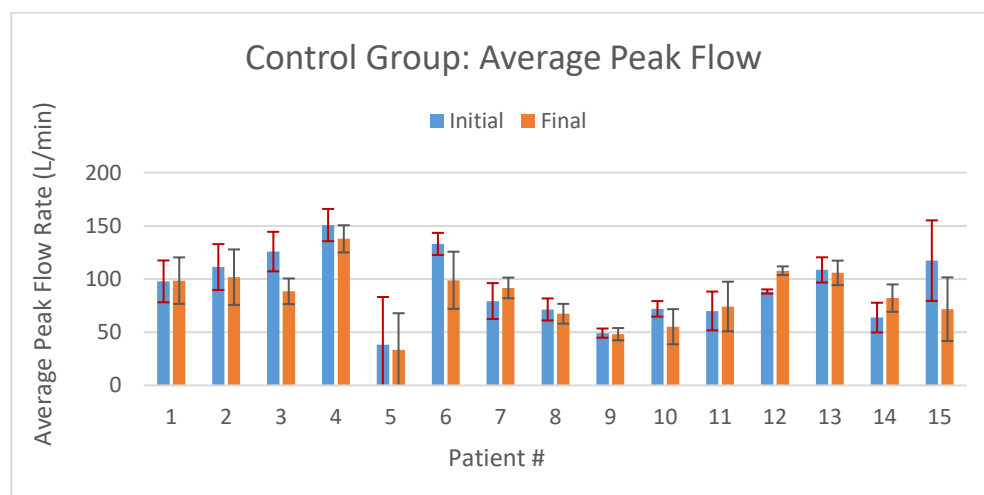


Figure 2 – Showing the average (sd error bars) peak inhalation flow rates for the control group during the initial 1 month period and then the final 1 month period following training visit

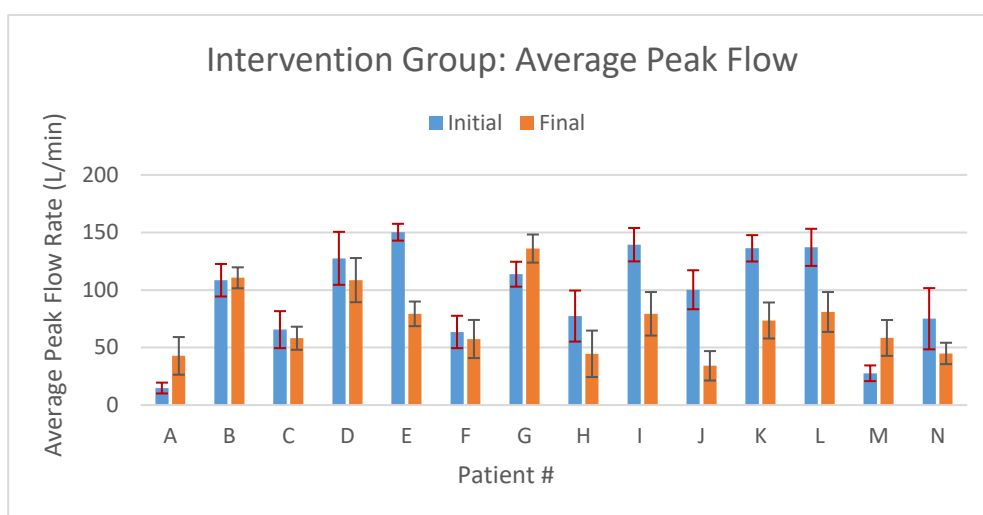


Figure 3 – Showing the average (sd error bars) peak inhalation flow rates for the intervention group during the initial 1 month period and then the final 1 month period following customized training based on Smart Spacer data.

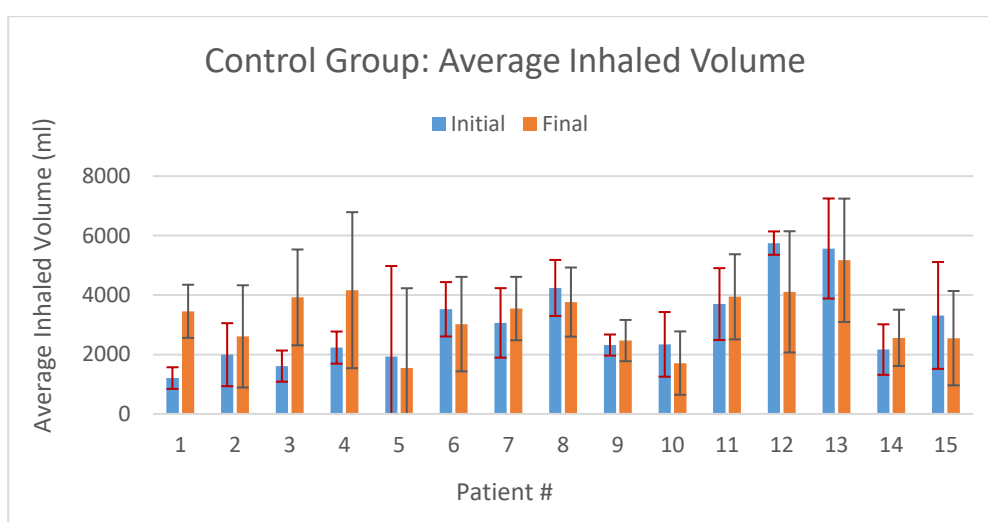


Figure 4 – Showing the average (sd error bars) inhaled volumes for the control group during the initial 1 month period and then the final 1 month period following training visit

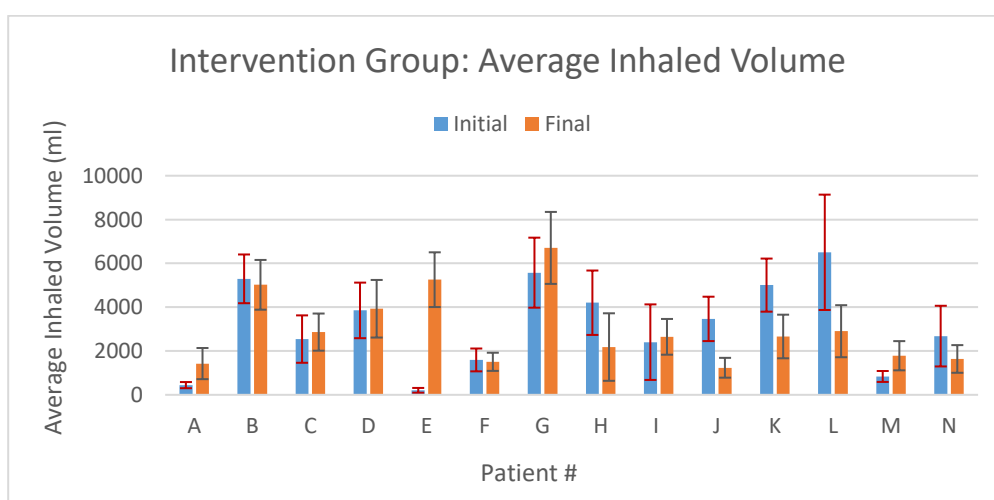


Figure 5 – Showing the average (sd error bars) inhaled volumes for the intervention group during the initial 1 month period and then the final 1 month period following customized training based on Smart Spacer data

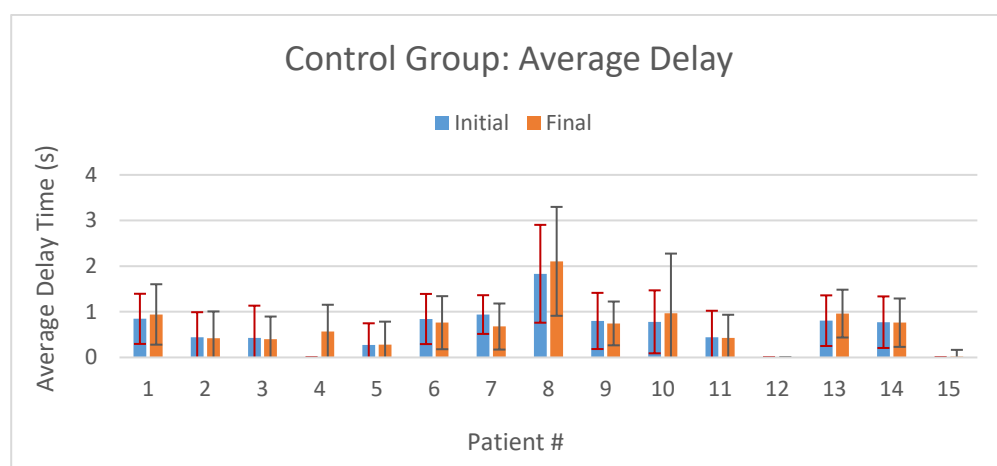


Figure 6 – Showing the average (sd error bars) inhalation delays for the control group during the initial 1 month period and then the final 1 month period following training visit

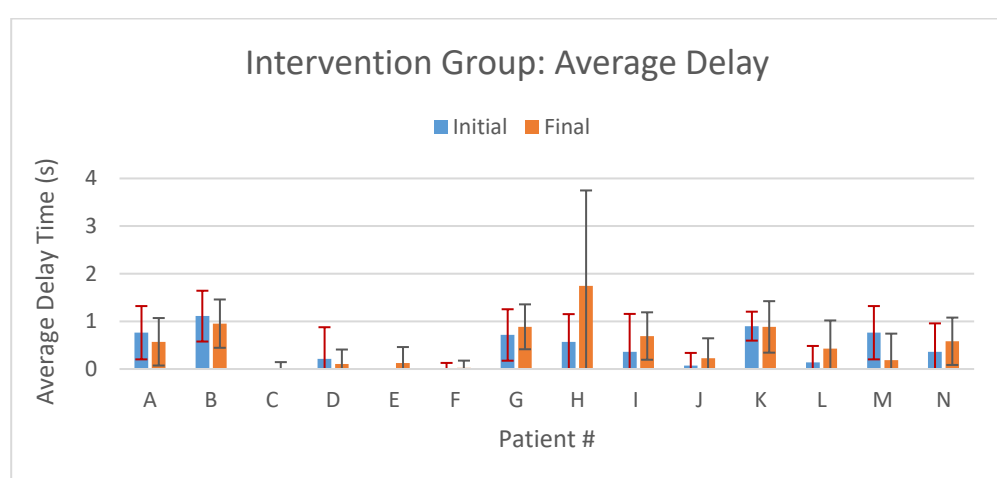


Figure 7 - Showing the average (sd error bars) inhalation delays for the intervention group during the initial 1 month period and then the final 1 month period following customized training based on Smart Spacer data

Discussion and Conclusions

Interestingly, despite usual care inhaler technique training at the start of the study, many patients had average peak inhalation flow rates that were higher than ideal. Twenty-one and 14 out of the 29 patients were above 70 and 100 l/min respectively during the first month. This technique error was corrected in a larger number of patients in the intervention group where the training at the 1 month visit focused on this specific aspect of technique.

Inhaled volume was generally satisfactory for this patient population, potentially helped in this case by the fact that patients in the Netherlands are typically trained to use a multiple tidal breaths technique (inhale multiple times through the Spacer with regular tidal breaths) rather than a single deep inhalation. Only 2 patients had flagged low inhaled volumes during the first month, both in the intervention group, and they both improved (higher volumes) following the customized training.

Inhalation delay technique was good for all patients throughout the study, with average delays between MDI actuation and inhalation being generally below 2 seconds. This metric may also have been helped by patients using a tidal breathing technique.

In future studies it would be useful to investigate if errors returned after time or if the face-to-face education enabled a sustained improvement. This could be compared versus patient self education through the use of on device real time feedback or via an application. It would also be interesting to evaluate an adult patient population who were trained with the single slow deep inhalation technique to see if the inhaled volume results remained generally good, as well as a paediatric population where one might anticipate smaller lung volumes.

In conclusion this study was able to provide interesting real-life insights into adult asthmatic inhalation techniques, highlighting the common and potentially detrimental (to drug delivery) error of high inhaled flow rate. The results also demonstrated the ability of the Smart Spacer to highlight specific errors, thus enabling the HCP to focus and tailor their consultation time on the key areas with subsequent improvements in technique observed.

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