Inhaler Technique

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Belgian Chocolate, French Champagne and Inhaled Medication: 
Too Good To Waste?

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Director of a commercial organisation that investigates inhaler devices and their use. (Canday Medical Ltd.)

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Do Health Professionals Have Sufficient Knowledge And Skill To Teach Optimum Inspiratory Flow (OIF)?
A Study Using The In-Check Dial™ (ICD) To Evaluate Inspiratory Technique

Introduction

limited therapy has become the main delivery route for medications for respiratory diseases such as asthma and COPD, there is now a large range of inhaler devices designed to deliver drugs directly to the lungs and minimize deposition outside the target area.

A consequence of the diversity of inhaler devices is that a technique that is standard for one device may be completely wrong for another. For example, certain dry powder inhalers (DPIs) work optimally at high inspiratory flows, whereas the pressurized metered-dose inhaler (SMD) provides optimum deposition only when the inhalation flow is slow.

Health professionals have a responsibility to instruct patients in optimal inhalation techniques, of which inspiratory flow is a key element. Achieving optimum inspiratory flow can produce a significant improvement in drug delivery to the lungs. While it is inadvisable to decide whether a patient should use their inhaler before the device is issued, it can be very difficult to assess visualisation of the device when most effective inspiratory flow is achieved.

The In-Check Dial™ is an inspiratory flow meter which indicates the inspiratory resistance of commonly used devices.

It can be set to simulate the inspiratory resistance of up to six different inhaler devices, by turning the dial to the appropriate setting. With the pressure loss circuit device can be attached. Each inspiratory flow reading is compared to those recommended as "optimum". The patient can then be informed in the correct inspiratory flow required.

Aim

To assess whether professionals with a specific interest in pulmonary medicine would correctly demonstrate the optimum inspiratory flow for three commonly prescribed delivery systems (MDI, Dry Powder Inhalers, and Accuhaler). The In-Check Dial™ (ICD) is used by simulating through the In-Check Dial™ as if they were demonstrating the optimum technique for each device.

Method

Dolatite at various inspiratory flows were interviewed, demonstrating inspiratory flows to the subjects. A standardised technique was adopted to those participating. Subjects were asked to inhale through an inspiratory flow meter until they were demonstrating the optimum technique for each device.

Using the In-Check Dial™ participants demonstrated the optimum technique for each device. The values of the flow device measurements were manipulated for each subject.

Discussion

The ICD is the generally used inhalation device in the UK and USA. It is a device that is used by all of the group of health professionals assessed in this study.

Most achieved an effective inspiratory flow for the BDP, but less than half achieved the optimum inspiratory flow for the Accuhaler and MDI. The ICD is a valuable tool in the assessment of inhalation technique.

Device-specific training programmes should be initiated for the "novice".

Percentage of Health Professionals achieving OIF

<table>
<thead>
<tr>
<th>Device</th>
<th>N</th>
<th>MCS</th>
<th>ICD</th>
<th>TDI</th>
<th>ACS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCUHALER</td>
<td>6</td>
<td>5.5</td>
<td>4.5</td>
<td>5.5</td>
<td>6.0</td>
</tr>
<tr>
<td>DRY POWDER</td>
<td>6</td>
<td>5.0</td>
<td>4.0</td>
<td>5.0</td>
<td>6.0</td>
</tr>
<tr>
<td>BDP</td>
<td>6</td>
<td>5.0</td>
<td>4.0</td>
<td>5.0</td>
<td>6.0</td>
</tr>
</tbody>
</table>

In-Check Dial™ is a trademark of Inhale Medical, Trelawney is a trademark of Asthma UK. This abstract was funded by AstraZeneca. This abstract is indexed by UPT."
Baverstock M, Woodhall N & Maarman V. Do Health Care Professionals have sufficient knowledge of inhaler techniques in order to educate their patients effectively in their use? Poster presented at Winter Scientific Meeting British Thoracic Society 2010
From the hit TV Series House MD on Fox NBC.
Video clip from Season 5 Episode 11 - when Dr. House asked a patient how she uses her inhaler.
http://www.youtube.com/watch?v=dMAS2S51bM8
“Poor Technique”

1. Lower than expected delivery to target site
2. Reduced benefits
3. Increased deposition in regions outside target site
4. Increased risk of side-effects
“Poor Technique”

.... But very happy to practice technique
UK: MDI and DPI Inhalation technique: inhalation too fast for pMDI, or too slow for DPI

- MDI: Too Fast 59.5%
- Turbuhaler: Too Slow 14.2%
- Diskhaler: Too Slow 57.0%
- Accuhaler: Too Slow 4.9%

Initial presentation – before training

163 COPD patients average age 72.5 years FEV1 47.8% predicted

“How would you inhale” challenge

Quick test of how you would inhale through commonly-used devices
- pMDI measurement first
- DPI measurement second

Need to:
1. Simulate resistance of device
2. Measure speed of inhalation

“How you would instruct the patient to inhale” using that type of inhaler

Single measurement

Results later ……. 
What type of Inhaler is this?

How does the aerosol get made?
What type of Inhaler are these?

How does the aerosol get made?
What type of Inhaler is this?

How does the aerosol get made?
What type of device are these?

How does the aerosol get made?
What type of Inhaler are these?

How does the aerosol get made?
Mean resistance of various DPIs

Resistance in \((\text{cmH}_2\text{O})^{1/2}\text{Lmin}^{-1}\)

Aeroliser  Accuhaler  Turbohaler  Clickhaler  Twighaler  Easyhaler

Fate of inhaled drugs – Good Technique

Schematic representation of potential dose distribution

Adapted from Barnes et al. AJRCCM 1998;157:S1-S53

Fate of inhaled drugs – Poor Technique

Schematic representation of potential dose distribution

Adapted from Barnes et al. AJRCCM 1998;157:S1-53

Why are there problems?

- **Design of inhalers vary**
  - Formulation of drug
  - Mechanical activation
    (passive MDI vs active DPI)
  - Internal resistance to airflow

- **Patients vary**
  - Pulmonary function
    (reversible Vs irreversible disease)
  - Ability to learn / be taught the correct technique
  - Physical size of lungs (child vs adult)
  - Effort varies from dose to dose
How changes in inspiratory flow affect output

Inspiratory flow

Low

High

Inhalation creates aerosol (e.g. DPI)

Lactose (in some DPIs)

Drug
Aerosol Deposition at varying Particle Size

- Micron size
  - 10: Pharynx, larynx & Upper respiratory tract
  - 5: Optimal tracheobronchial deposition
  - 2: Optimal alveolar deposition
  - 0.5: Particles exhaled if <0.5 micron
  - 0: Particles exhaled if <0.5 micron

Deposition

Diagram: Nasal Cavities, Pharynx, Larynx, Trachea, Bronchus, Lungs
n.b. note the angles in the airways
Particle Deposition In Respiratory Tract

Three mechanisms of aerosol kinetics govern the majority of particle deposition within the respiratory tract.

1. Inertial impaction
2. Sedimentation
3. Diffusion

Most important  Least Important
Particle Deposition In Respiratory Tract

Three mechanisms of aerosol kinetics govern the majority of particle deposition within the respiratory tract.

1. Inertial impaction
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3. Diffusion

Most important \[\rightarrow\] Least Important

Mass

Speed

Gravity

Brownian motion*

* Whitley Bay Smoke Chamber

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Implications

Metered Dose Inhalers
Lung deposition from pMDIs is influenced by inspiratory flow.

Implications

Spacer Devices
Spacer Devices – How they help

1. Capture aerosol avoiding coordination problems
2. Reduces particles deposited in oropharynx

Implications

Dry Powder Devices
Total emitted dose at different flow rates

This does not necessarily correlate with clinical effectiveness
Please tell me the right inhalation technique for each of the inhalers below......

Aerosol produced for you – inhale GENTLY
Please tell me the right inhalation technique for each of the inhalers below……

You create aerosol – inhale **FORCEFULLY**
Assessment & Training Devices
Monitoring inspiratory flow rate through the device

Vitalograph’s Aerosol Inhalation Monitor (AIM)

Canday Medical’s “2-Tone” Trainer
(www.2ToneTrainer.com)

Allen & Hanburys’ Accuhaler Trainer

Schering-Plough’s Twisthaler Trainer

AstraZeneca’s Turbohaler Usage Trainer & Turbutesters

Clement Clarke’s In-Check and In-Check DIAL

Fyne Dynamic’s MagFlo
1. Patients to receive consistent inhaler technique training from GPs, Nurses, Pharmacists etc.
2. HCPs to MEASURE patients ability to use inhaler (In Check DIAL)
3. Targeted patients for maximum early benefit
4. Following training, MDI patient to be supplied with a free 2Tone
5. Strategy employed across primary and secondary care
6. Directed MURs for CPs
7. Enhanced service (MUR plus) for children offered by CPs
8. Train a trainer, including outside NHS
9. Extend to Schools, care homes, housebound etc.
Baseline – Respiratory Medication status

- Annual spend: Inhaled corticosteroids > £1.7M
- Highest in Southern England
- Trend increasing

Expenditure:
- Respiratory Medicines (overall)
- Short-acting beta agonists
- Inhaled corticosteroids

2007: +20%
2007: +11%
2007: +6%

IOW Medicines Management Data; Data on file 20th November 2008
Outcomes – Respiratory Medication status

- Data collected over 9 month period
- No other interventions took place in Respiratory Medicine

IOW Medicines Management Data ; Data on file 20th November 2008
Outcomes – Effects on patients

9 months data 2008 vs 2007

- Emergency admissions to hospital due to asthma (n=20 vs 41)
- Hospital length of stay due to asthma - 50%
- Asthma related deaths (n=2 vs 8)

Data collected over 9 month period
No other interventions took place in Respiratory Medicine

IOW Medicines Management Data; Data on file 20th November 2008
Points to take away

1. Internal **resistance** affects speed of inhalation

2. Speed of inhalation affects **DPI device efficacy** (little effect on MDI)

3. Speed of inhalation and **particle size** affect how much drug is deposited in the lungs – and how much in the mouth and throat

4. Before initiating a new therapy, practitioners should check inhaler technique. Inhalation should be: **GENTLE** for a device that creates the aerosol for you (e.g. MDI), but **FORCEFUL** for those that rely on the energy of inhalation (e.g. DPI)

5. **NMR / CDS / MURs** and **Asthma Reviews** present unique opportunity to identify poor inhaler technique – but HCPs need to know good technique first!

6. Evidenced by IOW project: NICE reference: [http://tinyurl.com/6j9s5zv](http://tinyurl.com/6j9s5zv)

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