Sherbet Fountains and Inhaler Devices – What do they have in common ?

(Getting the most from inhaler devices)

Thursday 10th April 2008

Jon Bell

Short

Canday Medical Limited

Who ?

Pharmaceutical companies – sales & marketing, then clinical research

Medical device company – peak flow, spirometry, inspiratory (In-Check)

Present – independent research "inspiratory" – measurement & training

(Asthmatic; triggers - cat dander + lime cordial)

Aims / Goal ?

1. Promote improved care through better understanding of basic aerosol science and device characteristics
2. Minimise waste with inhaled drug therapies
3. Increase respiratory MURs through application of knowledge of how devices work, and how to achieve optimum technque – no matter what device patient has.

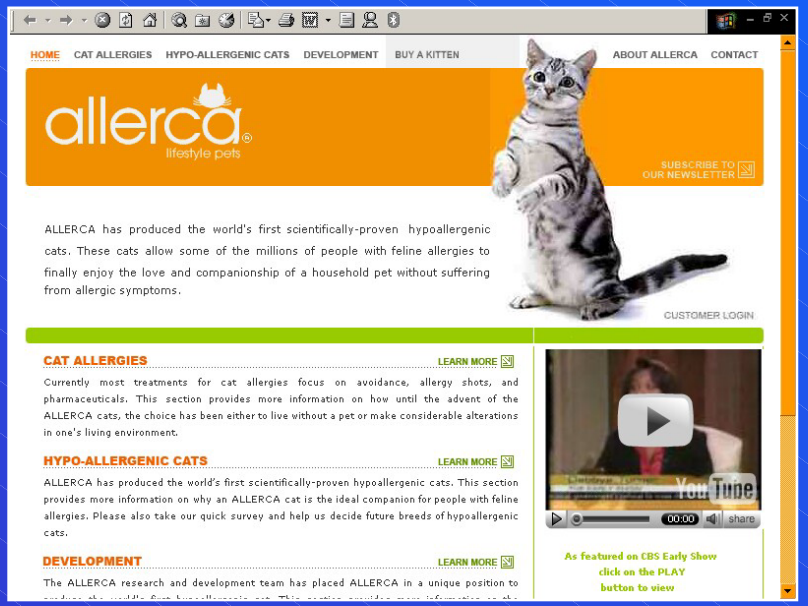

Clinical Respiratory

Optimising inhaler technique

PATIENT EDUCATION

Many professionals cannot demonstrate correct inhaler technique, says Jon Bell

Asthma and Pets



Medications for Asthma Management

- "Reliever" Meds
- Taken as needed
- To relieve acute airflow obstruction and bronchoconstriction
- Primarily **Beta$_2$-Agonists**

"Blue" inhaler

- "Preventer" Meds
- Taken daily, long-term
- To reduce inflammation
- Primarily **inhaled corticosteroids**

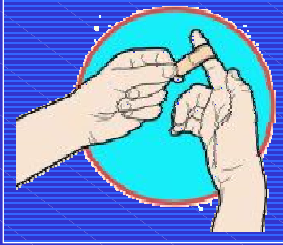
"Brown" inhaler

- Combination products

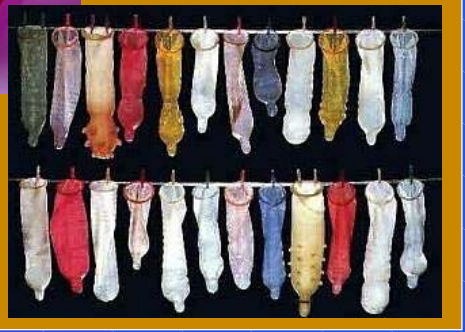
"Purple" or "Red/White" inhaler

The importance of explaining asthma medications

Relievers

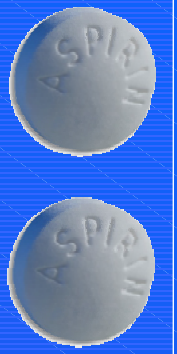


Preventers



Consequence of poor compliance

Increased use of relievers …..



…and reduced protective effect

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Could we do something similar to explain COPD medications ?

Asthma UK estimates that 2.1 million patients in the UK are suffering unnecessarily because they do not use their asthma treatment effectively.

An estimated 75% of hospital admissions for asthma are avoidable and as many as 90% of the deaths from asthma are preventable.

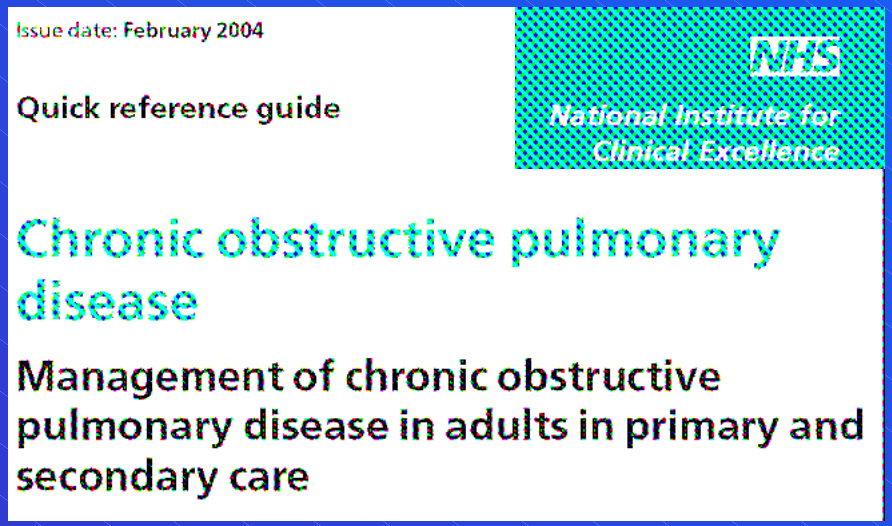
http://www.asthma.org.uk/news_media/media_resources/for_1.html

Last accessed: 3rd October 2007

UK: MDI and DPI Inhalation technique: inhalation too fast for pMDI, or too slow for DPI

Al-Showair R, Tarsin W, Assi K, Pearson S, Chrystyn H Can patients with COPD use the correct inhalation with all inhalers and does training help ? Res Med 2007: 101, 2395-2401

Guideline recommendations
(NICE COPD 2004)


Issue date: February 2004

Quick reference guide

NHS National Institute for Clinical Excellence

Chronic obstructive pulmonary disease

Management of chronic obstructive pulmonary disease in adults in primary and secondary care

Delivery systems

Inhalers

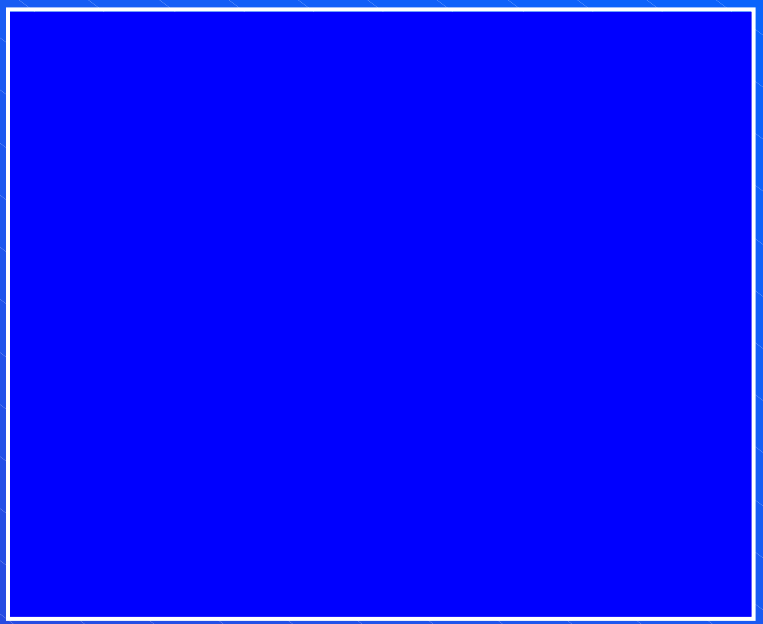
- Most patients, whatever their age, can learn how to use an inhaler unless they have significant cognitive impairment.
- Hand-held devices are usually best, with a spacer if appropriate. D
- If a patient cannot use a particular device, try another. D
- Teach technique before prescribing an inhaler, and check regularly. D
- Titrate the dose against response for each patient. D

…but what if the half the dose is wasted each time the inhaler is used ….

"How do *you* inhale" challenge

Quick test of how you would inhale through commonly-used devices

- pMDI measurement first
- DPI measurement second



Need to:

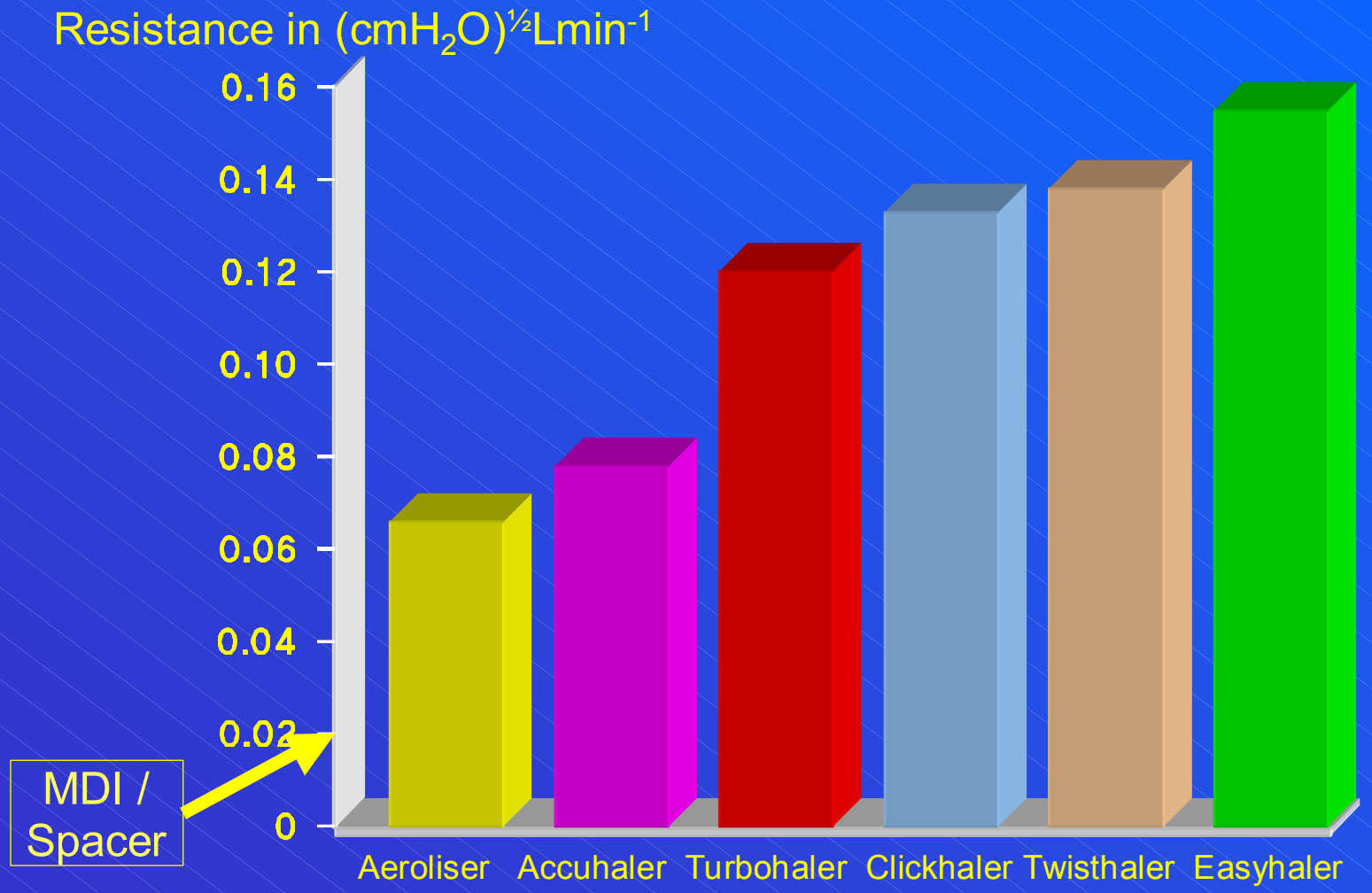
1. Simulate resistance of device
2. Measure speed of inhalation

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

Single measurement

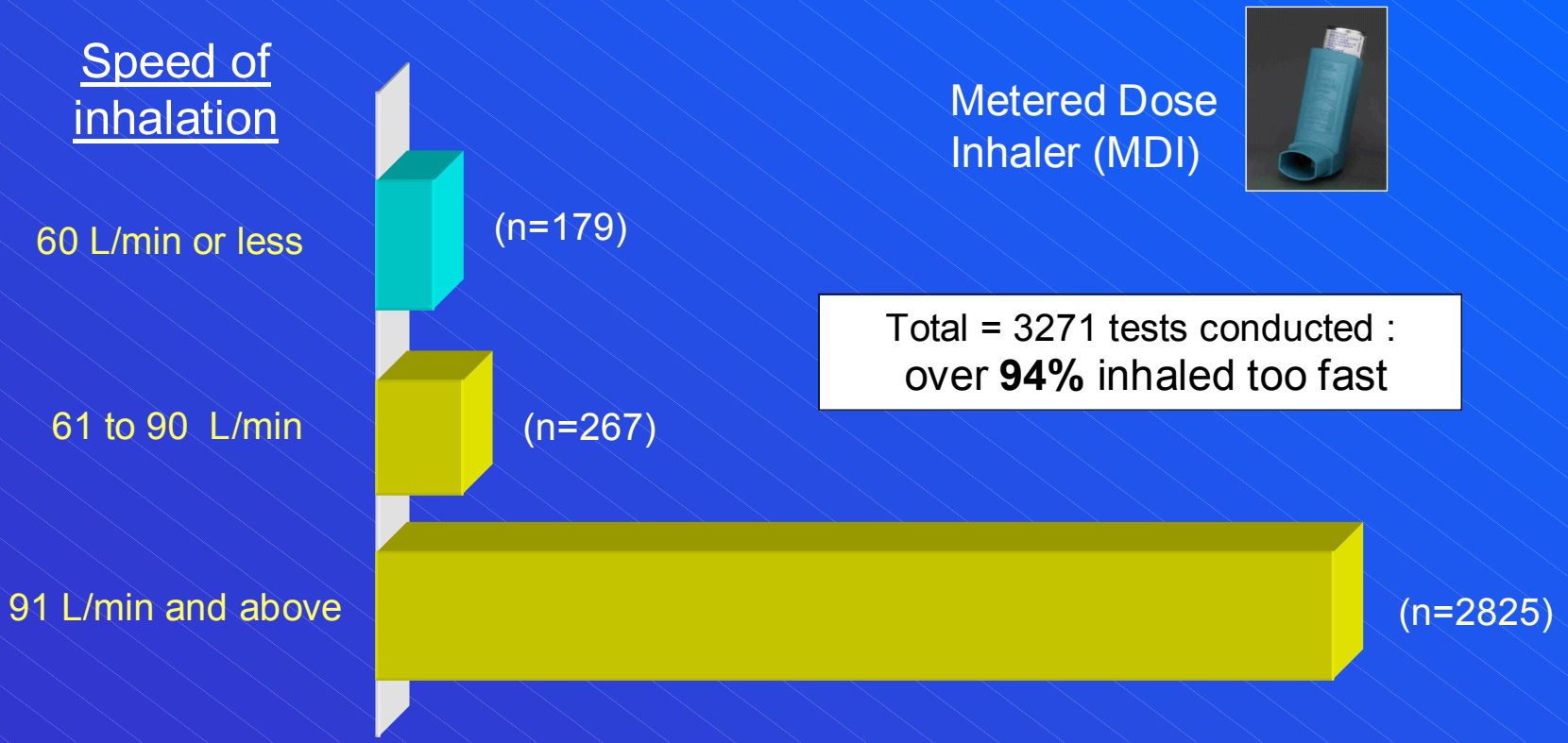
Results later …….

Mean resistance of various DPIs



Assi KH, Chrystyn H. The different resistance of dry powder inhalers (DPIs). Am. J Respir. Crit. Care Med. 2001;163(5): A443 (Adapted from)

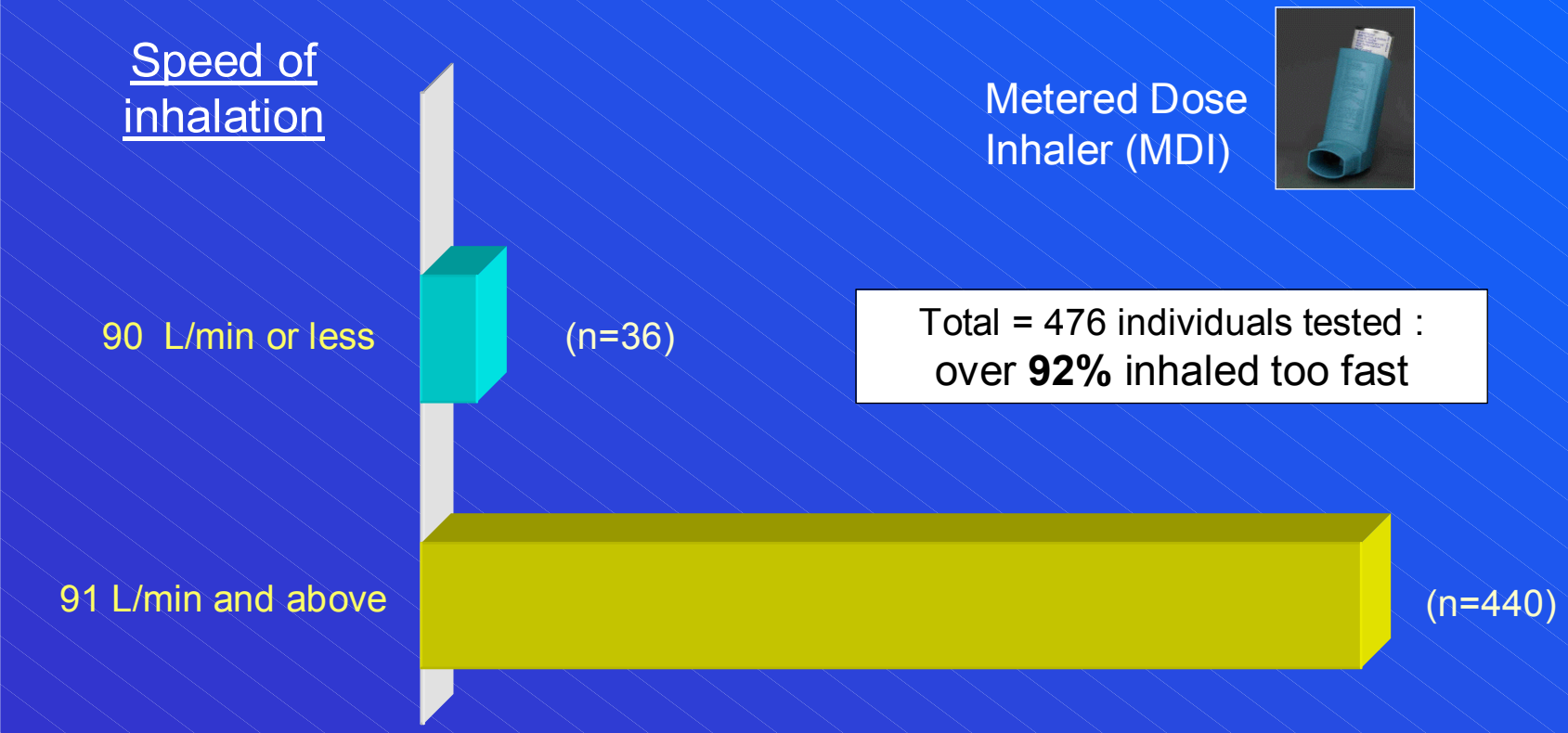
Health Professionals speed of inhalation when asked to inhale as if using an MDI - "Slowly and Deeply"



General Practitioners, Practice Nurses, Respiratory Nurses (Primary & Secondary Care), Pharmacists (Community, Retail and Hospital), Pharmacy Dispensers, Prescribing Advisors, Physiotherapists, Hospital Physicians (General Medicine and Thoracic), Pharmaceutical Company Employees (Representatives, Medical Advisors, Educational Staff)

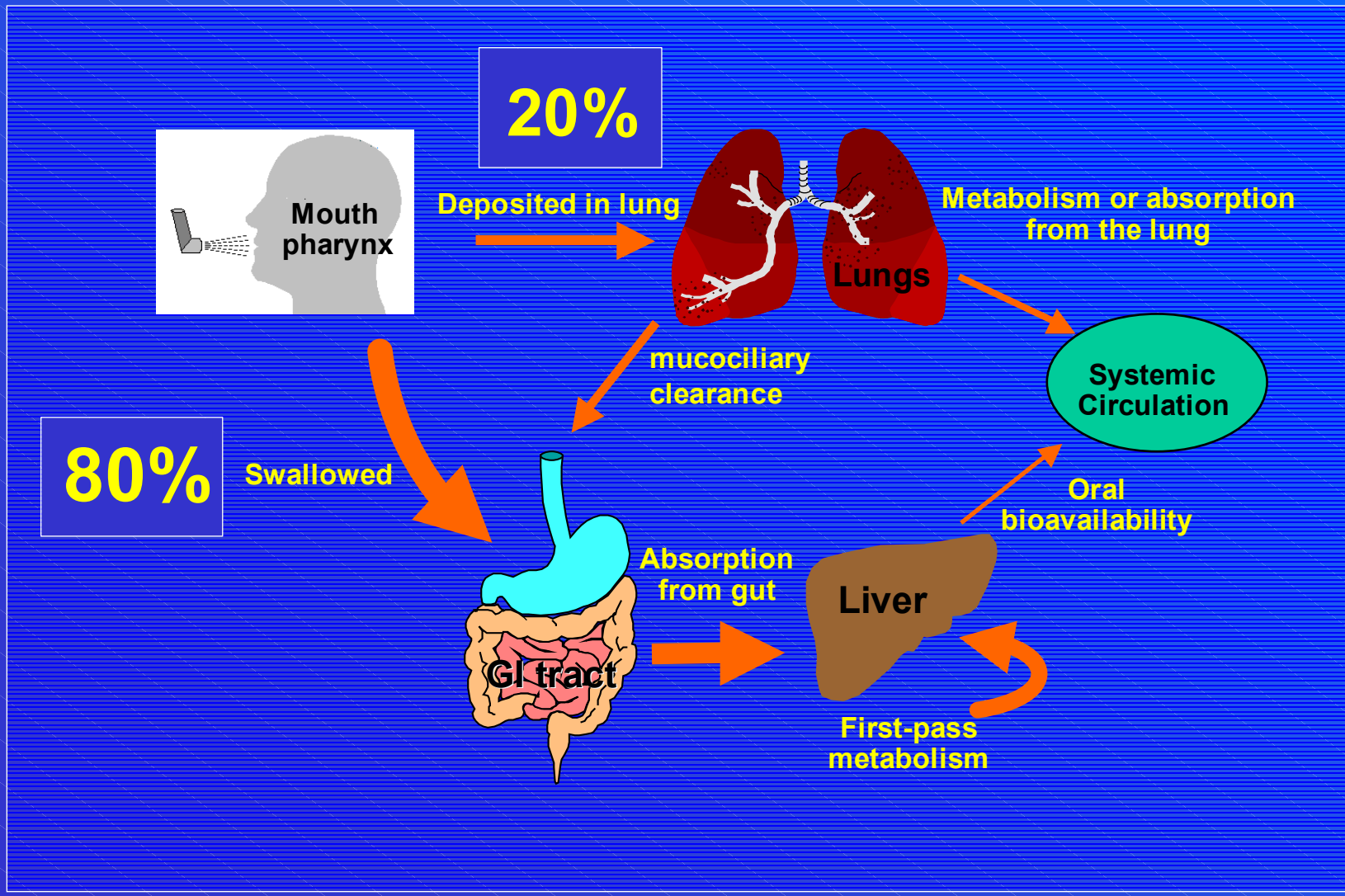
Presented at ERS Annual Scientific Meeting, Stockholm 2007 (No. 91, Primary Care Day, 15/9/07):
Jon Bell, Canday Medical Ltd. data collected between 1st June 2006 and 5th September 2007

Asthmatics - speed of inhalation through Metered Dose Inhaler

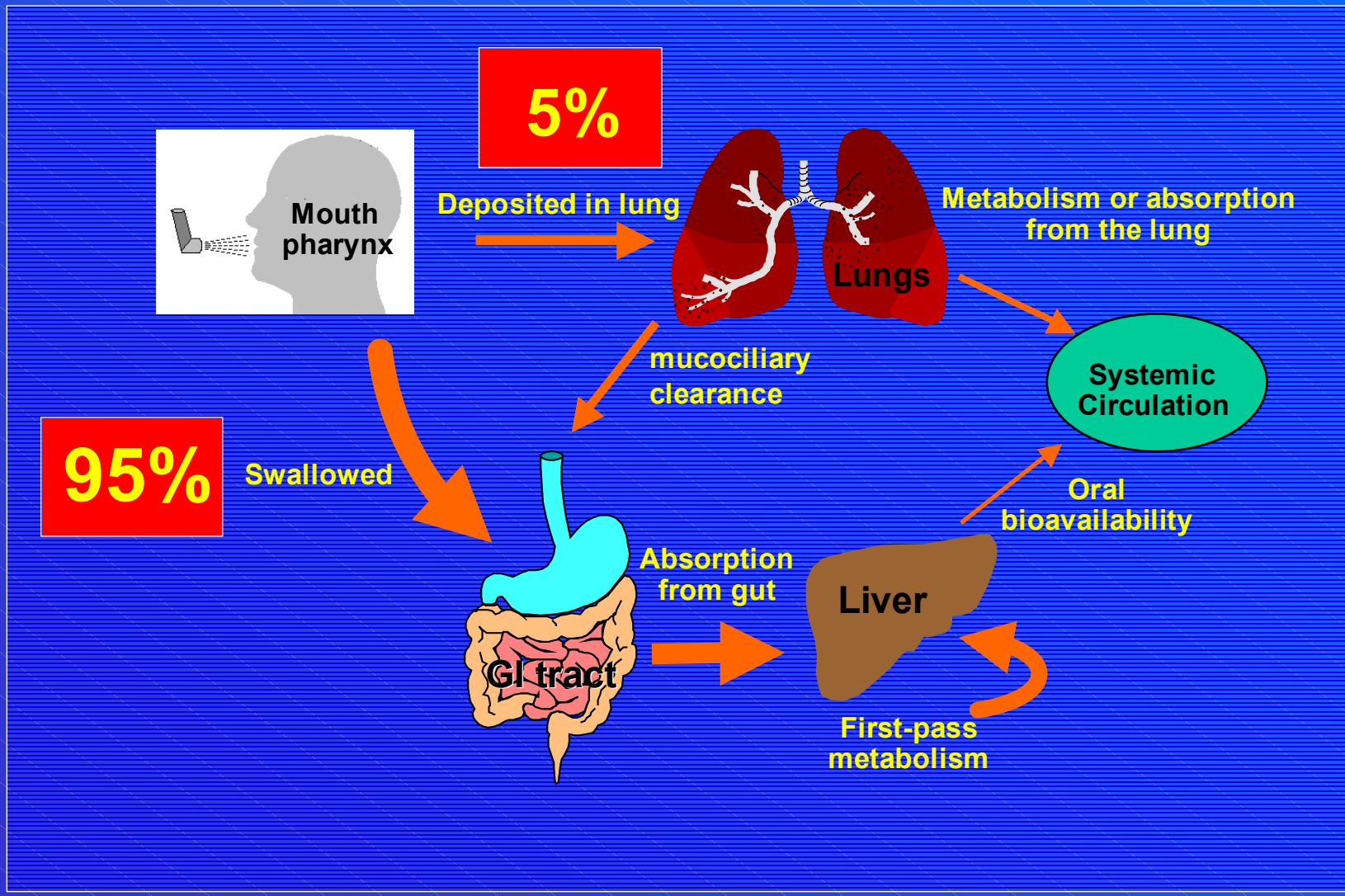


Al-Showair R A M , Pearson S B, Chrystyn H. The Potential of a 2Tone Trainer To Help Patients Use Their Metered-Dose Inhalers Chest 2007; 131: 1776-1782

Fate of inhaled drugs – Good Technique



Fate of inhaled drugs – Poor Technique



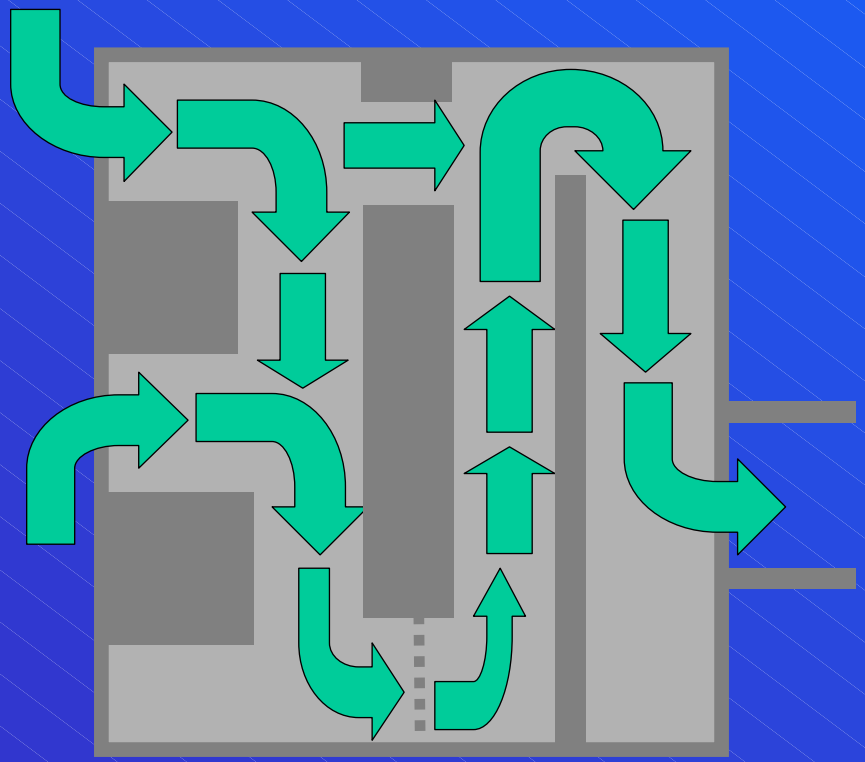
Why are there problems ?

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

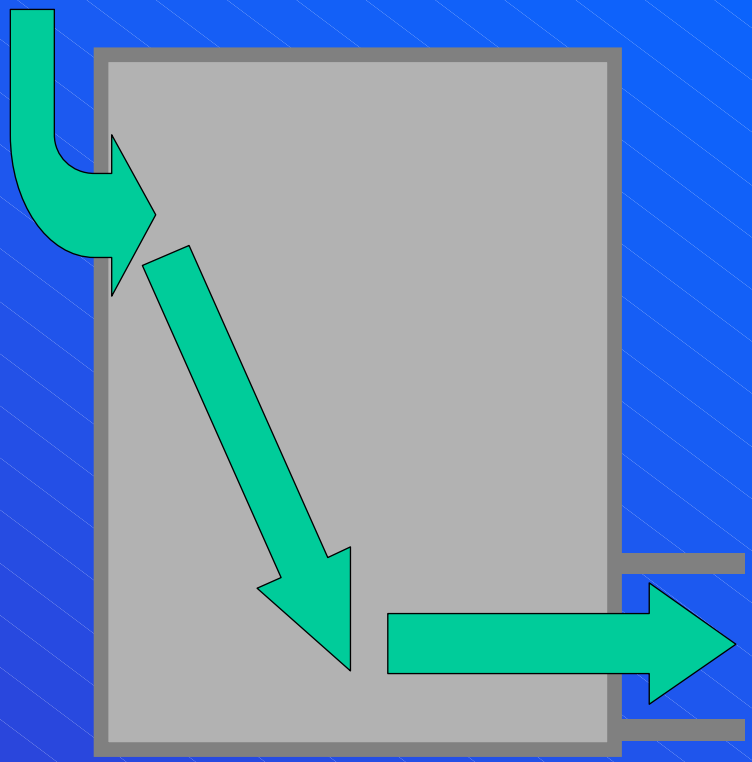
inappropriate selection and/or incorrect inhaler technique

- 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

External shape hides internal differences



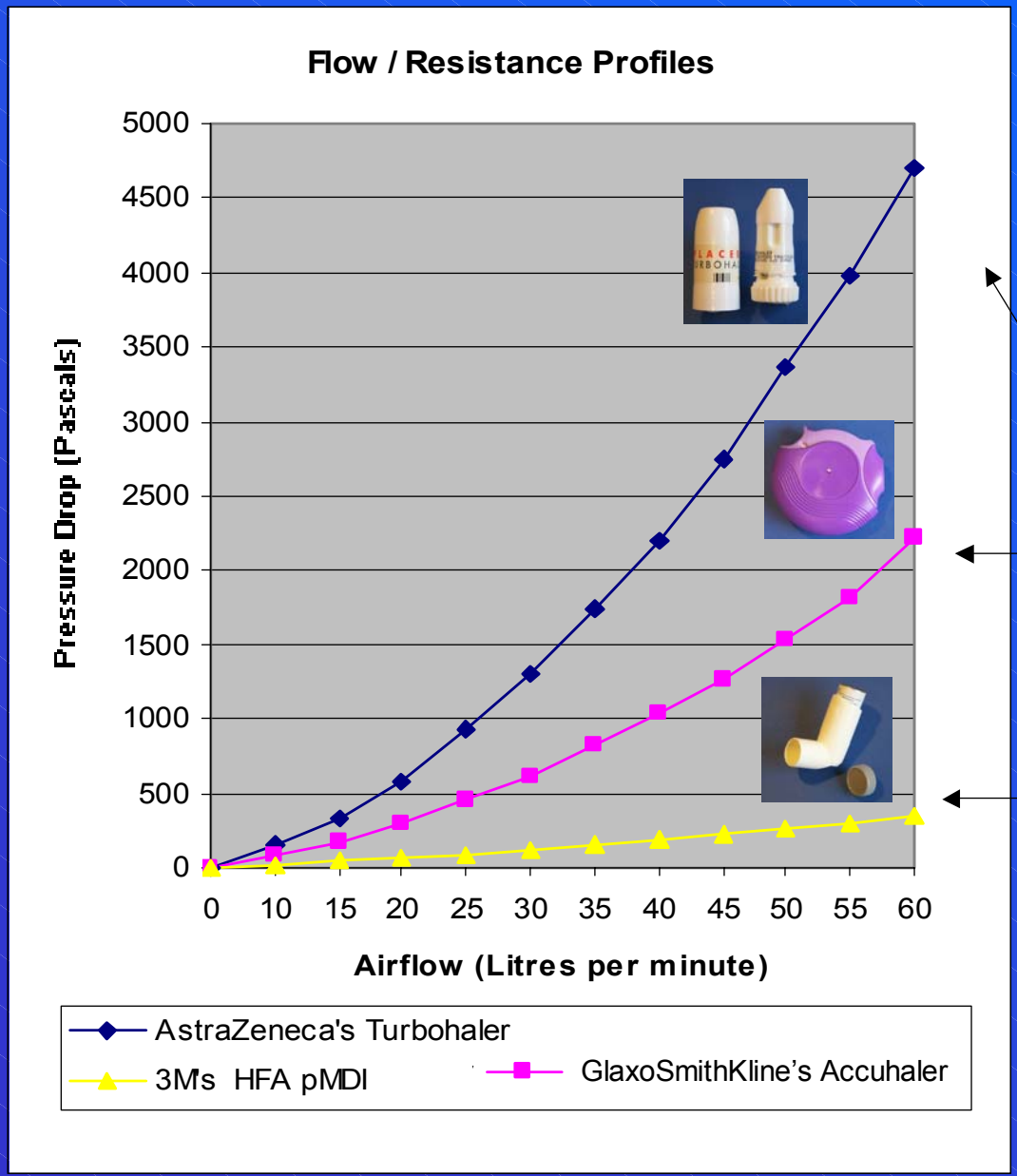
High resistance



Low resistance

Resistance of 3 Common Inhalers at different flow rates

(placebo versions)



Dry powder device

pMDI aerosol "puffer"

Ref: J Bell 2004, data on file: jon@canday.co.uk

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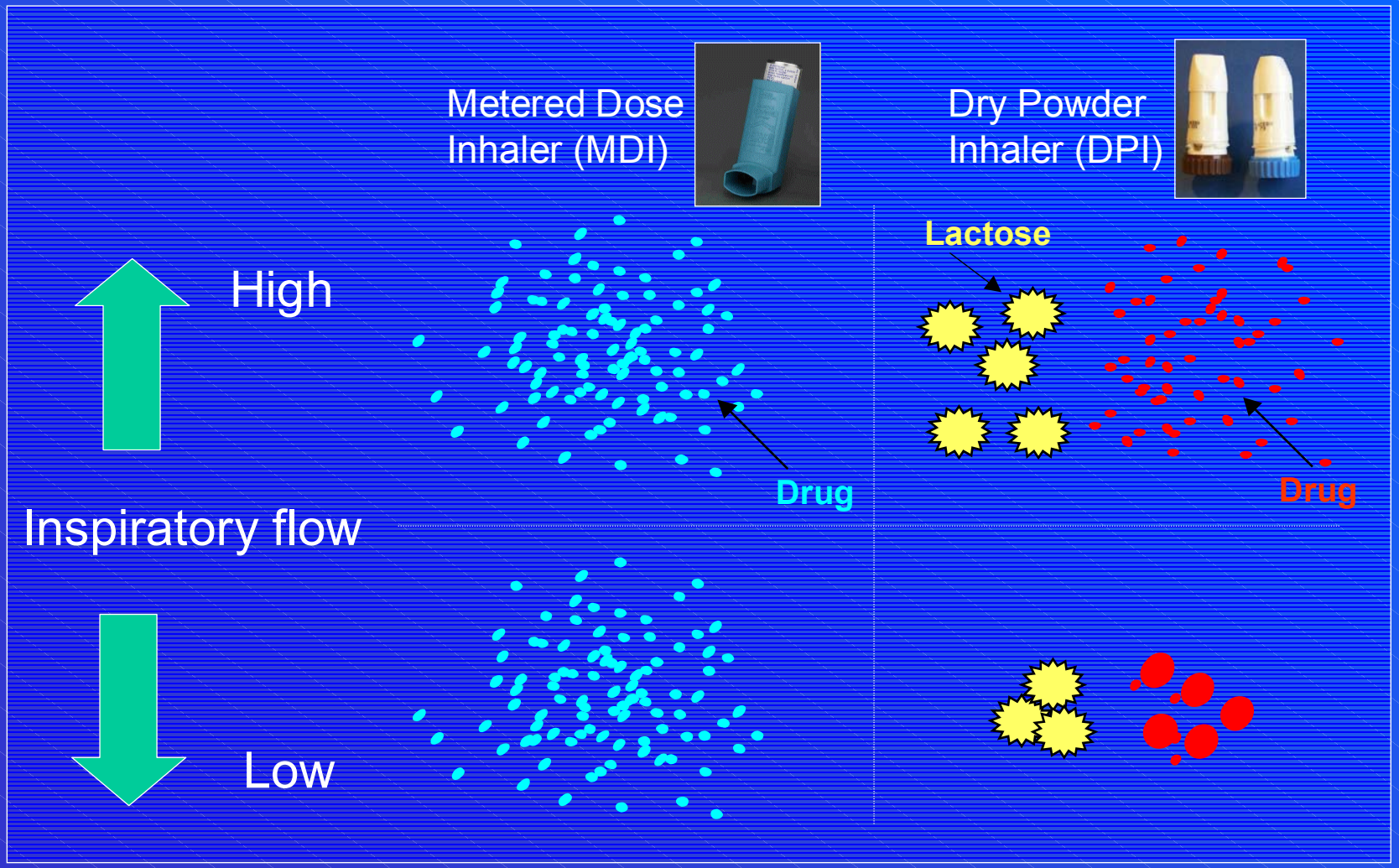
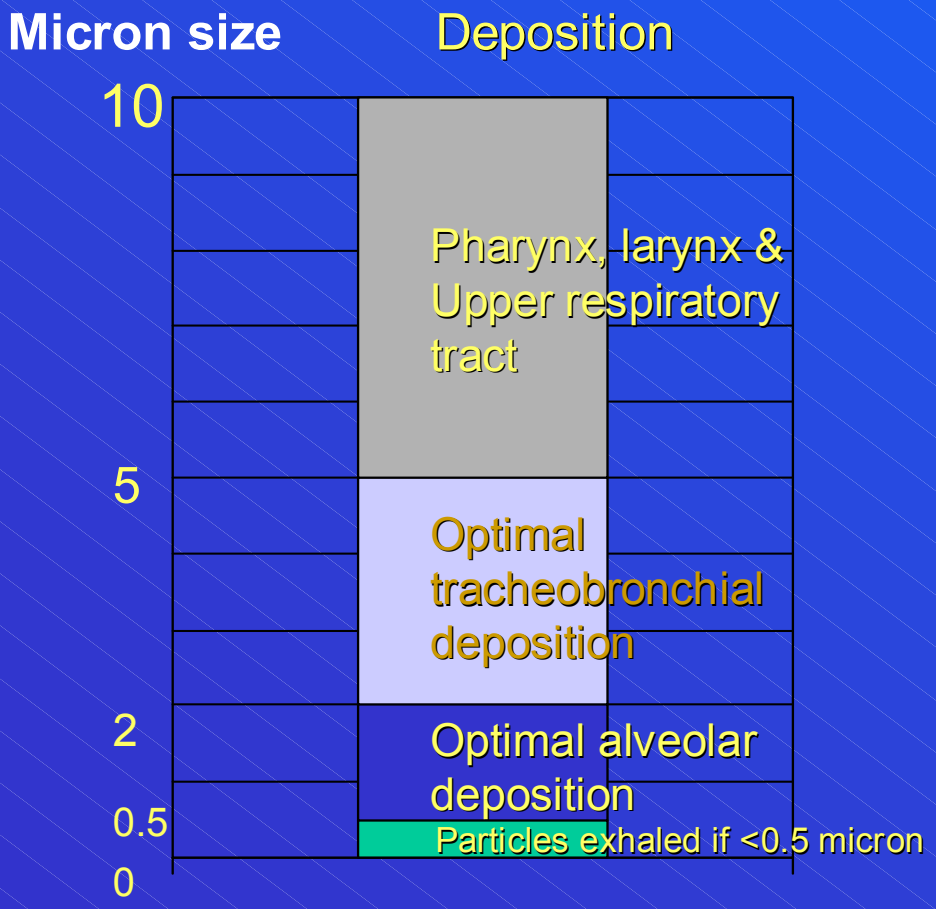
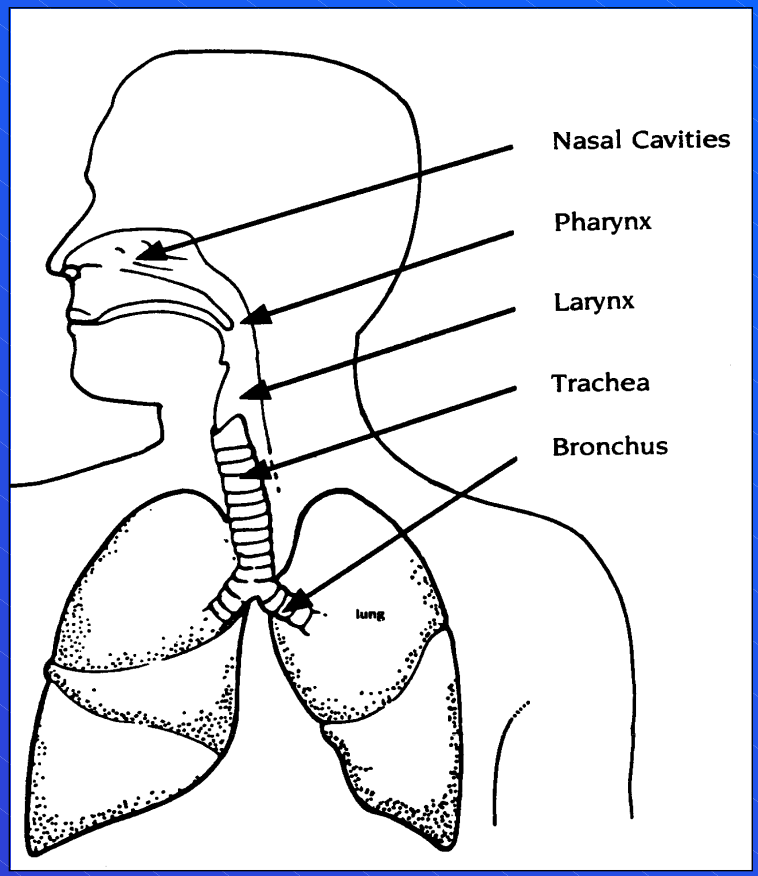
Changes in inspiratory flow affect the aerosol output from two types of portable inhaler



Aerosol Deposition at varying Particle Size





Facio-Maxillary View (lateral)

Right Bronchogram

n.b. note the angles of 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
90%

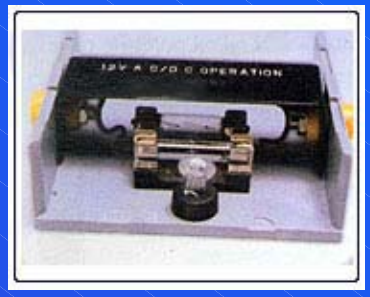
Mass

Speed

2. Sedimentation
9%

Gravity

3. Diffusion
1%



Brownian motion*

* Whitley Bay Smoke Chamber

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What have sherbet fountains got in common with inhalers …….

Twisthaler

pMDI

Turbohaler

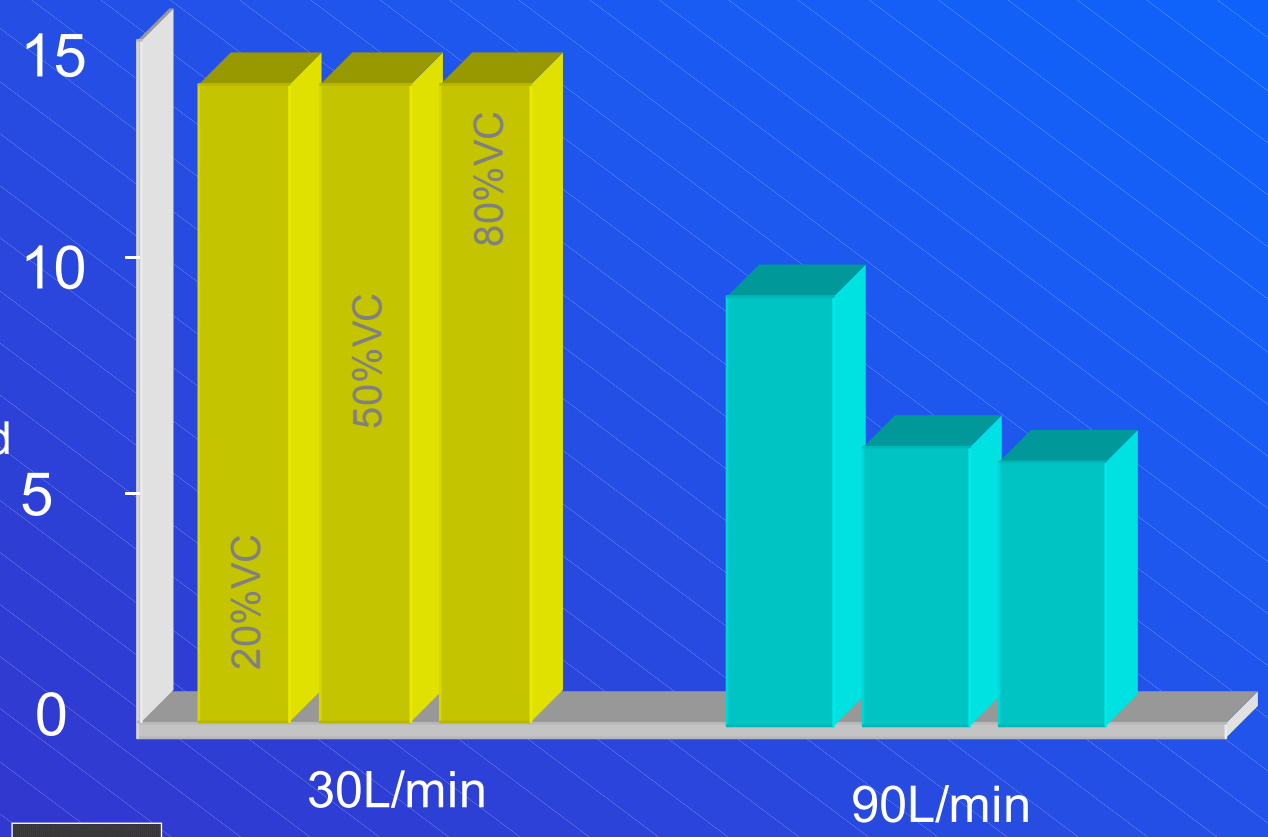
Handihaler

Accuhaler

Implications

Metered Dose Inhalers

Lung deposition from pMDIs is influenced by inspiratory flow



Total lung deposition

(% of inhaled dose)

10 second breath hold

Metered Dose Inhaler (MDI)

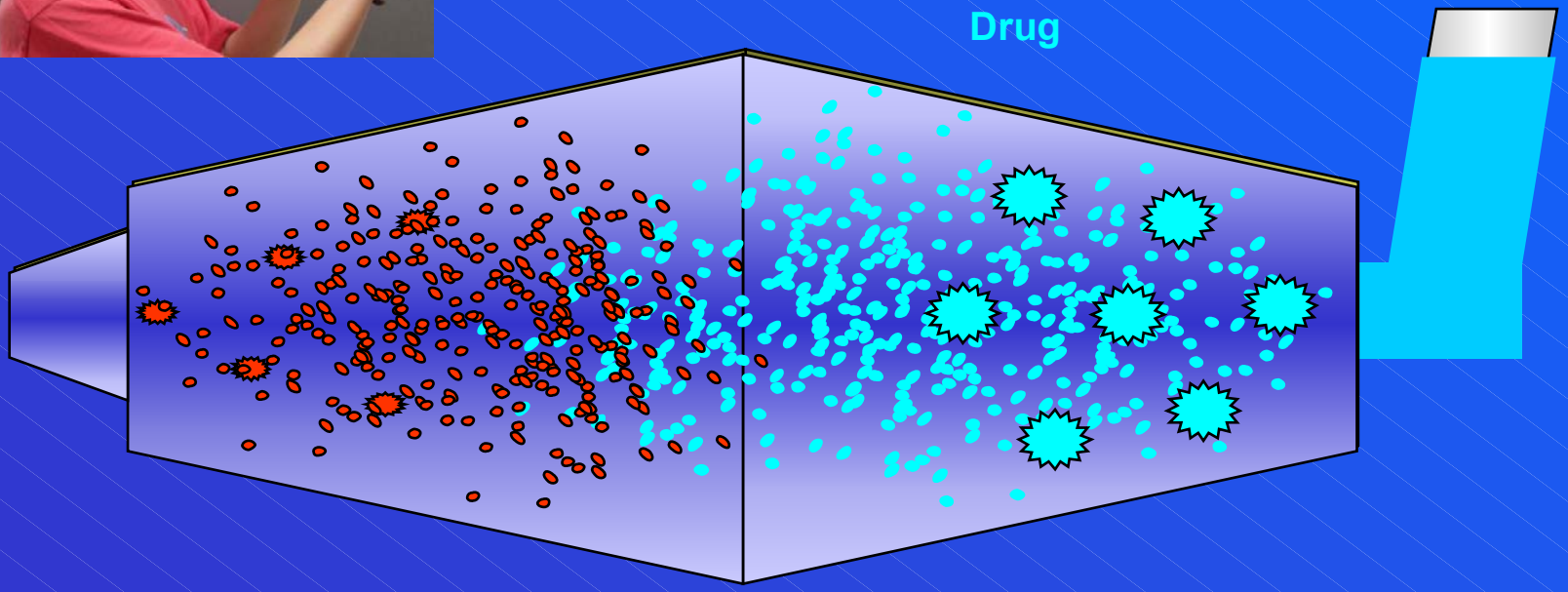
Newman S et al, Eur J Respir Dis 1982;63: Suppl 119 57-65

Implications

Spacer Devices

Spacer Devices – How they help

Metered Dose Inhaler (MDI)



1. Capture aerosol avoiding coordination problems
2. Reduces large aerosol particles (associated with s/e)

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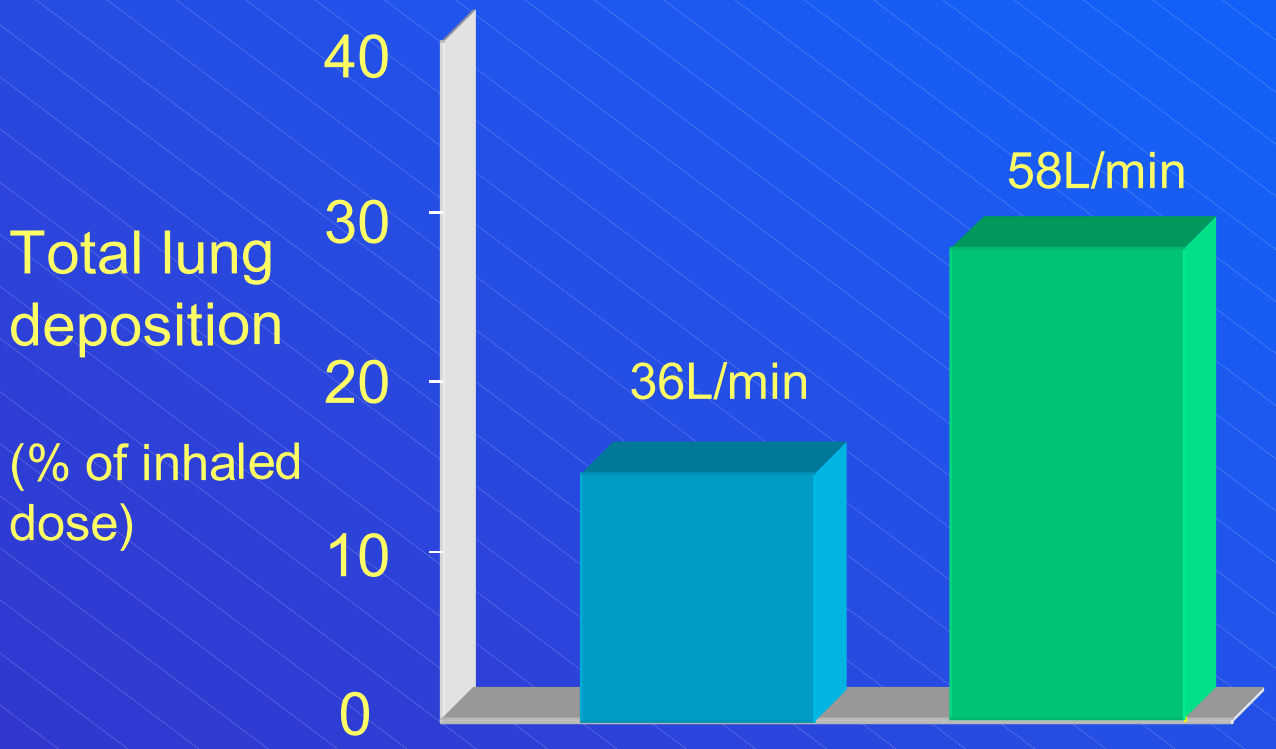
Errors in Technique No. 129

Asthma patient audit : 1 patient, Male 55yr
28 salbutamol MDI Rx in last 12 months
2000 mcg BDP
Poor inhaler technique
L. Vol. Spacer repeatedly prescribed

Implications

Dry Powder Devices

Lung deposition from Turbohaler is influenced by inspiratory flow

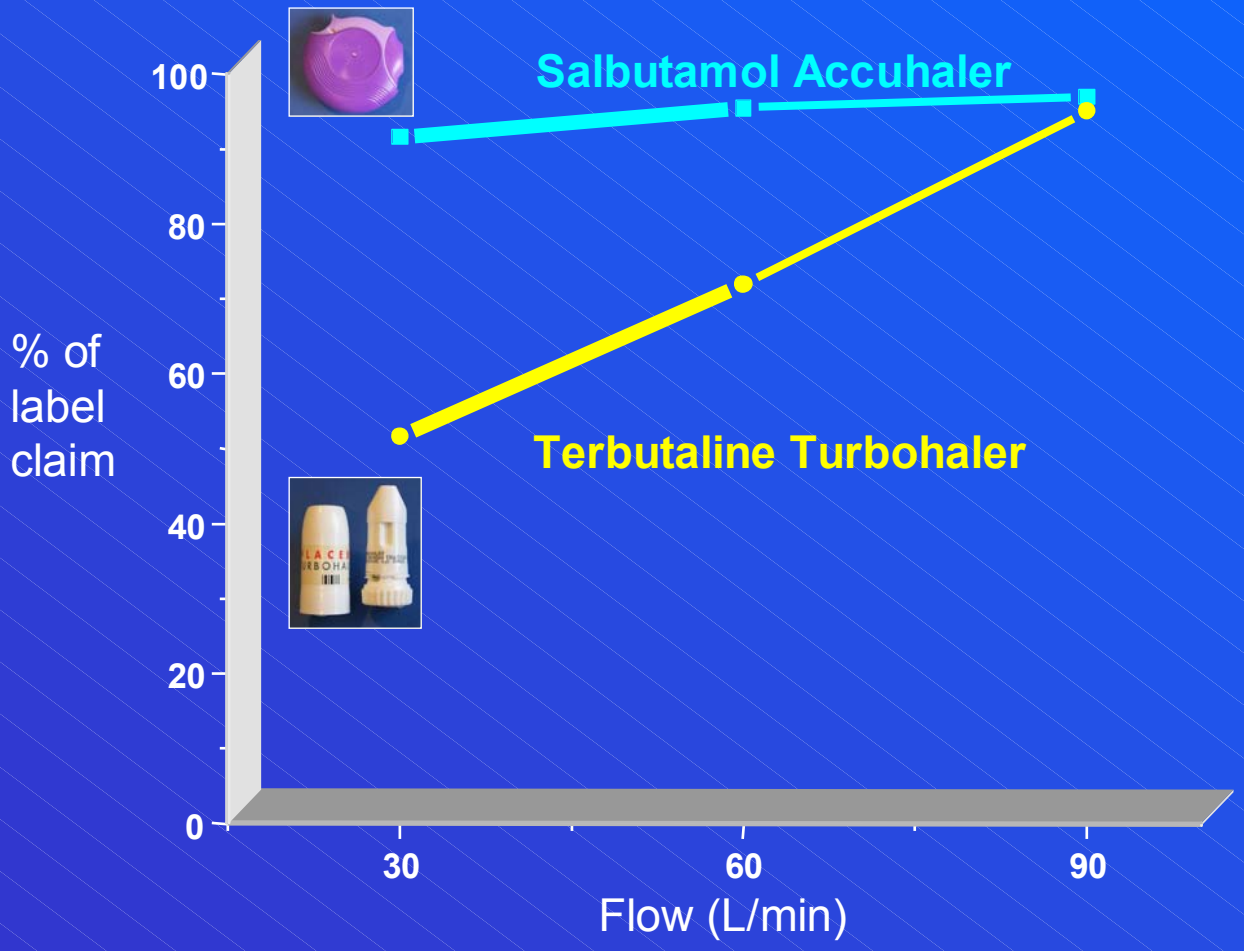


Lung deposition from a budesonide Turbohaler measured by gamma scintigraphy.

Dry Powder Inhaler (DPI)

Borgstrom et al Eur Respir J 1994;7:69-73

Total emitted dose at different flow rates



Malton et al, J Pharm Med 1996:6:35-48

Application of PIF Measurement

Application of existing flow measurement technology

Measures speed of exhalation
PEF (l/min)

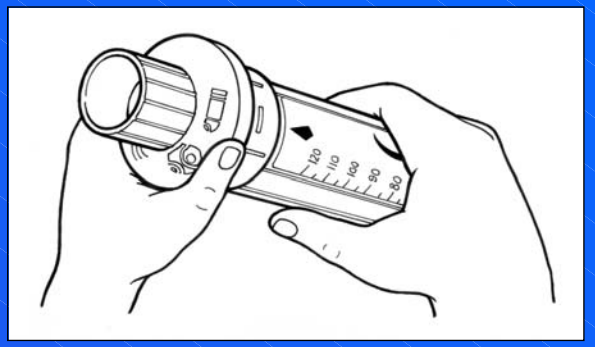
- Diagnosis for reversible airway disease
- Monitor response to treatment
- Identify provocative factors
- Objective input for self-management

Measures speed of inhalation
PIF (l/min)

- Measure inspiratory flow for inhaler used
- Identify poor inhalation technique
- Demonstrate optimal technique for inhaler
- Objective feedback on teaching success

- (with facemask) monitors allergic rhinitis morbidity (Peak NASAL inspiratory flow – PNIF)

1. Turn the DIAL to select the inhaler resistance



(Diskus / Accuhaler)

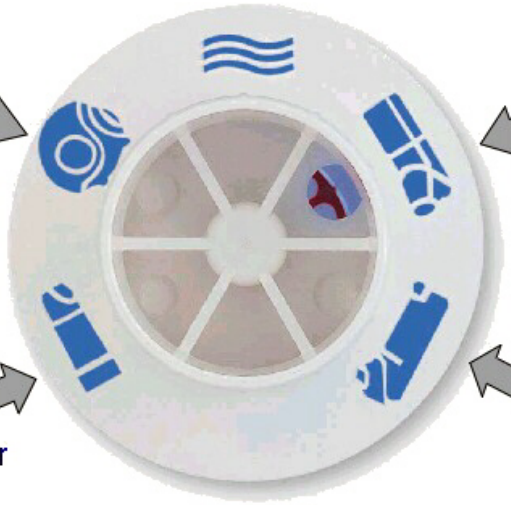
Multiple-dose powder inhaler

(Common pMDI)

Metered Dose Inhaler and MDI spacers with low resistance (e.g. AbleSpacer)

(Easibreathe)

Automatic pMDI



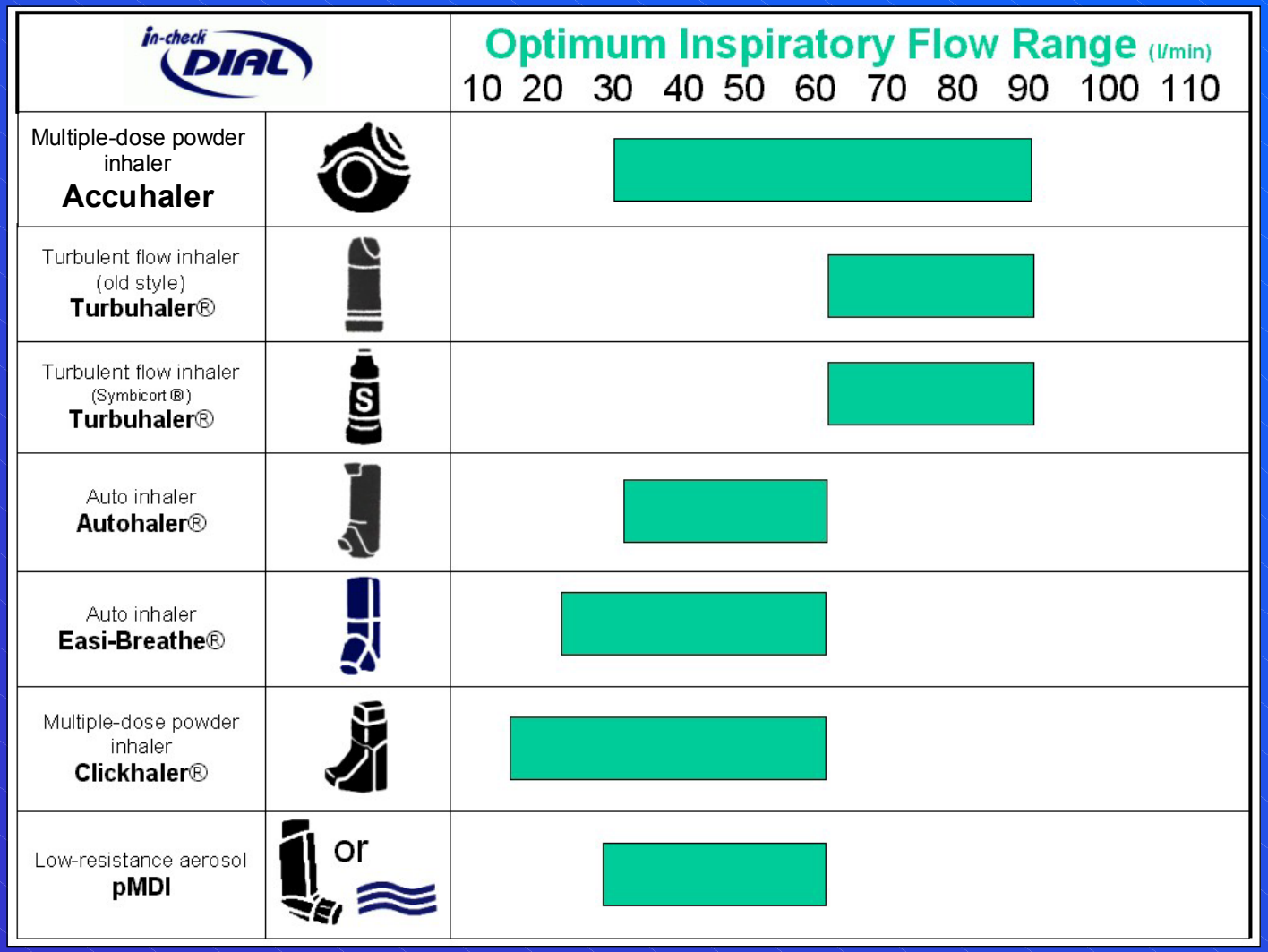
(Turbuhaler)

Turbulent flow inhaler

(Autohaler)

Automatic pMDI

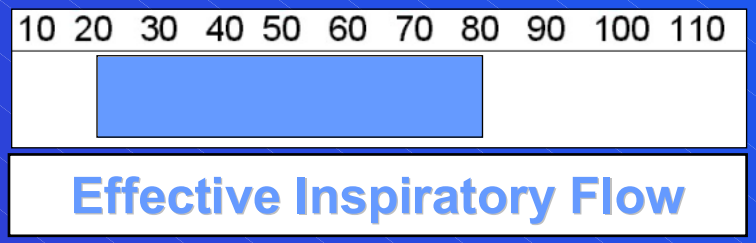
2. Measure, then compare the inspiratory flow achieved with the optimum recommended for that device



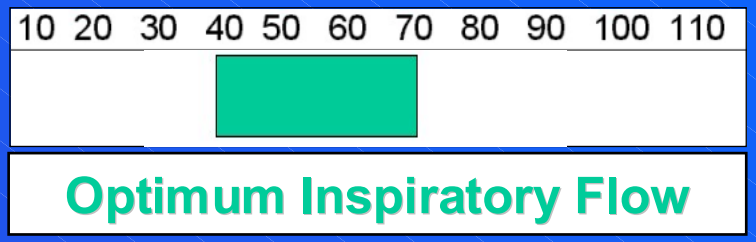
"Optimum"
Or
"Effective"

?

Is there a difference between "effective" and "optimum" ?



vs.



1. Clinical effect observed

1. Lung deposition is maximised
2. Oropharyngeal deposition is minimised
3. Clinical benefit is maximised
4. Side-effect risk is minimised
5. Inhaler provides greater dose consistency

The optimum inspiratory flow range for each device has been ascertained after reference to pharmaceutical data - summary of product characteristics (SPC), promotional and educational literature (from the manufacturers) and clinical and laboratory studies.

What if asthma and COPD were treated with Chocolates and Champagne ?

£5 to £20 a box

£15 to £35 a bottle

Would you allow people to waste 50% every time they had some ?

Assessment & Training Devices

Monitoring inspiratory flow rate through the device

Independent

Vitalograph's Aerosol Inhalation Monitor (AIM)

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

Fyne Dynamic's MagFlo

Canday Medical's "2-Tone" Trainer

(www.2ToneTrainer.com)

Pharmaceutical Co.

60 L/min

35 L/min

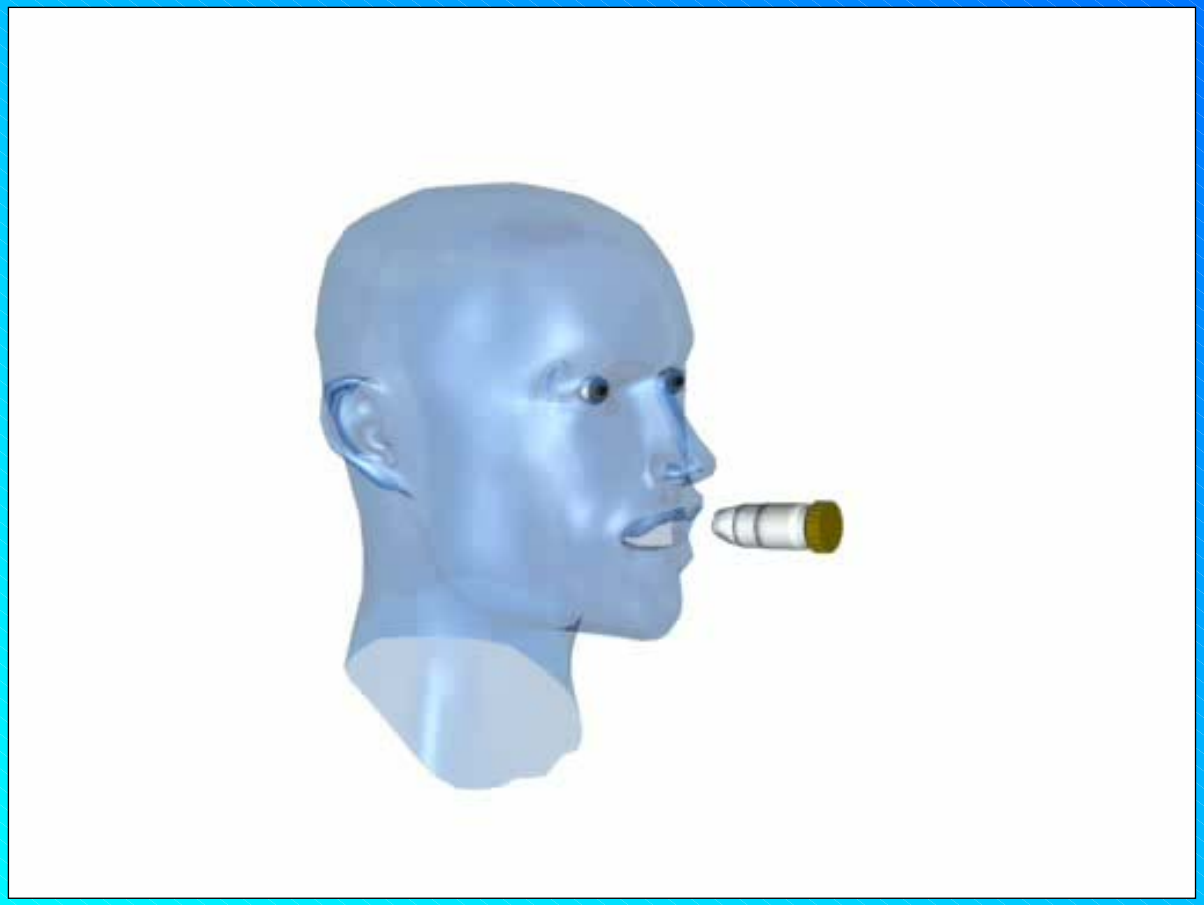
AstraZeneca's Turbohaler Usage Trainer & Turbutesters

Schering-Plough's Twisthaler Trainer

Inhale Too Fast…. (e.g. pMDI)

High-speed aerosol cloud impacts in oropharynx

Inhale Too Slowly…. (e.g. DPI)



Reduced emitted dose and quality of aerosol at low speed

Inhale Optimally (e.g. pMDI)

Optimal PIF for inhaler efficiency and aerosol dynamics

Points to take away ?

1. Internal **resistance** affects speed of inhalation
2. Speed of inhalation affects **DPI device efficacy** (less effect on MDI)
3. Speed of inhalation affects how much drug is **deposited** in the lungs – and how much in the mouth and throat
4. Teaching **optimum technique** (rather than just any technique that shows clinical effect) offers real and immediate benefits for both patient and professional.