MDIs and spacers and DPIs, oh my!

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Disclaimer

- Most of what we will discuss today is not technically “new”
Asthma

- most common chronic disease in childhood
- epidemiology
  - gender
  - SES
  - rural vs urban
- burden of disease
  - missed school days, hospitalization, mortality

** mortality due to asthma is largely preventable **
Asthma: Pathophysiology

- airway hyperreactivity → inflammation & airway narrowing → cough, wheeze, shortness of breath

http://www.asthma.ca/adults/about/whatIsAsthma.php
## Inhalation therapy: History

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>1500 BC</td>
<td>burning of herbal preparations for inhalation</td>
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<td>1800s AD</td>
<td>first use of ceramic inhalers</td>
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<tr>
<td>1850s</td>
<td>invention of atomizers/nebulizers</td>
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<td>1930s</td>
<td>creation of electric jet nebulizer (Germany)</td>
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<tr>
<td>1956</td>
<td>first MDI product arrives on market (Medihaler)</td>
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<td>1970</td>
<td>first breath-actuated MDI</td>
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<td>1988</td>
<td>first true multi-dose DPI introduced (Turbuhaler)</td>
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<td>1995</td>
<td>first CFC-free MDI</td>
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<tr>
<td>2003</td>
<td>FDA recommends dose counters be incorporated in all MDI designs</td>
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*Respir Care 2009;54(4):455-7*
MedicaMundi 2010;54(3): 47-53.
New asthma devices

- diagnosis
- treatment
- monitoring of therapy
Nitric oxide analysis

- exhaled NO (FeNO) = indirect marker of airway inflammation
- useful in diagnosis of asthma, and ongoing monitoring of treatment
- FENO 2-4x higher in asthmatics
- less accurate in children < 4 yrs old
The new NIOX MINO® is here!
For Airway Inflammation Control
- The number one device for NO measurements
- Now more than 4 million tests performed world wide
- Maintenance and Calibration free
- Quality assured NO values

Asthma devices

- diagnosis
- treatment
- monitoring of therapy
Nebulizers

- aerosolize drug in solution via vibration or air expansion
- variability in drug deposition based on device, drug volume, flow rate, humidity
- generally inefficient means of drug delivery
Nebulizers

- **Advantages**
  - no special administration techniques
  - simultaneous administration of multiple medications

- **Disadvantages**
  - less portable
  - time consuming
  - equipment maintenance/cleaning
  - less predictable drug delivery
Advances in nebulizers

- breath-enhanced nebulizers
  - valve technology to recirculate medication
- vibrating mesh nebulizers
  - portable, battery-operated, minimize drug loss to evaporation
- breath-actuated nebulizers
  - deliver aerosol only on inspiration
http://www.aerogen.com/products/aeroneb-go.html
Pressurized metered-dose inhalers (pMDIs)

- most common inhalation device worldwide
- consists of drug reservoir coupled to actuator
- metered doses delivered via propellant
- drug is either in solution or micronized in suspension
pMDIs

- **Advantages**
  - portable
  - time saving
  - less expensive
  - multi-dose system
  - patient acceptance
  - *relatively high lung deposition (newer devices)*

- **Disadvantages**
  - require significant coordination
  - teaching time to ensure proper use
  - *5-20% lung deposition (traditional MDIs)*
Advances in pMDIs

- dose counters
- propellants → switch to hydrofluoroalkanes (HFA)
- breath-actuated inhalers (eg. SmartMist®)
  - enhance drug delivery by minimizing breath coordinating difficulties
- breath-coordinated inhalers (eg. Optihaler®)
  - teach proper inhalation technique
Figure 6 - SmartMist® (Aradigm Corporation, USA). Published with permission of the manufacturer.
Dry powder inhalers (DPIs)

- micronized powder for inhalation
- propellant-free
- particle delivery driven by inspiratory flow
Dry powder inhalers (DPIs)

- **Advantages**
  - easier to use (breath-actuated)
  - portable
  - time saving
  - multi-dose system

- **Disadvantages**
  - dependant on patient inspiratory flow rate
  - device-specific instruction
  - particle agglomeration
  - more expensive than MDIs
  - ↓ lung deposition in patients with poor lung function?
Advances in DPIs

- air classifier technology (eg. Novolizer®, Airmax®)
  - cyclonic airflow on inhalation
- battery-powered delivery systems (eg. Spiros®)
  - ↑ drug delivery with ↓ inspiratory flow rates
- new powdered formulations
  - microparticle formation via spray-drying → porous particles with higher lung deposition
  - potential for sustained release
And beyond...

- solution metering or “soft mist” devices
  - propellant-free
  - utilize spring mechanism or electronic components to generate aerosolized liquid
  - Respimat®
    - portable
    - no power source or spacer device required
    - lung deposition ~ 40%
  - AERx®
    - electromechanical device to optimize inhalation technique
    - utilizes proprietary blister packed sterile doses in solution
Spacers
Spacers

● Advantages
  ● ↓ coordination difficulties when using MDIs
  ● ↑ drug deposition to pulmonary system
  ● ↓ oropharyngeal adverse effects (irritation, dysphonia, candidiasis)
  ● 50% reduction hospital admissions

● Advances
  ● volume, valve system, shape, material
New(ish) asthma drugs

- omalizumab (Xolair®)
  - monoclonal antibody which binds IgE and inhibits inflammatory cascade
  - powder for reconstitution
  - subcut injection q2-4 weeks
  - approved for use in pt ≥ 12 yrs with moderate or severe asthma & demonstrated reactivity to aeroallergen not controlled by ICS
New(ish) asthma drugs

- beclomethasone dipropionate (QVAR®)
  - smaller particle size (dosing not equivalent)
  - HFA propellant = lower velocity aerosols
  - reduced systemic effects?

- ciclesonide (Alvesco®)
  - once-daily dosing
  - pro-drug: converted to active metabolite in lung tissue
  - claims: targeted drug therapy, reduced systemic effects, reduced oropharyngeal adverse effects
On the horizon…

- combination products
  - new steroid/long acting bronchodilator combinations
  - once daily combination products
- biological agents
  - monoclonal antibodies, cytokine targets
- thermoplasty
Asthma devices

- diagnosis
- treatment
- monitoring of therapy
Peak flow meters

- measure peak expiratory flow
- daily variation in readings informs level of asthma control
- useful in hospital and outpatient settings
Asthma education

- benefits of comprehensive asthma education:
  - ↓ rates of hospitalization, school absenteeism, nighttime asthma symptoms
  - improved lung function, self-efficacy, quality of life

- education components:
  - pathophysiology of asthma
  - appropriate medication use
  - prevention/treatment of symptoms
    - peak expiratory flow monitoring
    - trigger recognition/avoidance
    - developing asthma action plan
**Child Asthma Action Plan**

0-5 years of age

**Health Care Provider’s Name:**

**Medical Record #:**

**Health Care Provider’s Phone #:**

**Completed by:**

**Date:**

### Long-Term Control Medicines

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<th>How Much To Take</th>
<th>How Often</th>
<th>Other Instructions</th>
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### Quick-Relief Medicines

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**Child is well**

and has no asthma symptoms, even during active play.

**PREVENT** asthma symptoms every day:

- Give the above long-term control medicines every day.
- Avoid things that make the child’s asthma worse:
  - Avoid tobacco smoke, ask people to smoke outside.

**Child is not well** and has asthma symptoms that may include:

- Coughing
- Wheezing
- Runny nose or other cold symptoms
- Breathing harder or faster
- Awakenings due to coughing or difficulty breathing
- Playing less than usual
- Other symptoms that could indicate that your child is having trouble breathing may include:
  - Difficulty listening (grunting, sounds poor sucking)
  - Changes in sleep patterns, crying and tired, excessive appetite

**CAUTION.** Take action by continuing to give regular asthma medicines every day AND:

- Give [ ]

If the child is not in the Green Zone and still has symptoms after 1 hour:

- Give [ ]

**Child feels awful! Warning signs may include:**

- Child’s wheezes, cough, or difficulty breathing continues or worsens, even after giving yellow zone medicines.
- Child’s breathing is so hard that he/she is having trouble walking/talking/playing/speaking.
- Child is drowsy or less alert than normal.

**MEDICAL ALERT! Get help!**

- Take the child to the hospital or call 9-1-1 immediately!
- Give more [ ]

**Call 9-1-1 if:**

- The child’s skin is sucked in around neck and ribs, or
- Lips and/or fingernails are gray or blue, or
- Child doesn’t respond to you.

**Danger! Get help immediately!**

Adapted and reprinted with permission from the Regional Asthma Management and Prevention (RAMP) Initiative, a program of the Public Health Institute.

Role for pharmacy

- asthma education:
  - appropriate medication use
  - inhaler technique
  - trigger avoidance
  - peak expiratory flow monitoring

- influenza vaccination

- smoking cessation
Further Reading


Questions?