“Breathing is truly a strange phenomenon of life, caught midway between the conscious and unconscious and peculiarly sensitive to both.” Dickenson Richards, M.D. Columbia University College of Physicians and Surgeons Nobel Laureate in Medicine, 1956

Roses are red, Violets are blue; Without your lungs, Your blood would be, too

Goals and objectives for the pulmonary section:

I
- Understand important categories and causes of lung disease in the United States and around the world
- Understand lung mechanics in health and disease
  - Lung mechanics determination efficiency of ventilation
    - Compliance
    - $\frac{\Delta V}{\Delta P}$
  - Resistance
    - $P_{res}/P_{mouth}$
  - PEEP and Auto-PEEP

Roses are red, Violets are blue; Without your lungs, Your blood would be, too

Goals and objectives for the pulmonary section:

II
- Understand gas exchange in health and disease
  - Alveolar air equation and calculation of alveolar-arterial (A-a) gradient
    - $P_{aO_2} = P_{aCO_2} - \frac{P_{aCO_2}}{R}$
  - Oxygen delivery to tissues
    - $DO_2 = \dot{t} \cdot CaO_2$
    - $CaO_2 = ([Hgb] \times 1.39 \times % saturation) + (P_{aO_2} \times 0.0036)$
  - Mechanisms of hypoxemia
    - VQ mismatch
      - Corrects with oxygen breathing
    - Alveolar hypoventilation
      - Corrects with oxygen breathing
    - Diffusion limitations
      - Corrects with oxygen breathing
    - Exacerbated by exercise

Goals and objectives for the pulmonary section:

III
- Understand symptoms and signs of pulmonary disease
  - Symptoms
    - Dyspnea
    - Cough
  - Severity
  - Progression
  - Signs
    - Wheezing
    - Crackles (rales and rhonchi)
    - Diminished breath sound
    - Hyperresonant breath sounds
- Understand use of diagnostic testing in pulmonary disease
  - Pulmonary function testing
    - Restrictive and obstructive physiology
  - Arterial blood gas analysis
  - Chest radiograph
  - Lung pathology
    - Major types and patterns of injury and abnormality

Goals and objectives for the pulmonary section:

IV
- Understand treatment approaches to patients with lung diseases
  - Symptomatic treatments
  - Oxygen therapy
  - Bronchodilators
  - Mechanical ventilation and PEEP
  - Disease-specific treatments
    - Understand cellular and molecular basis of treatments for specific diseases
      - Steroids
      - Other immunosuppressives
      - Antibiotics
      - Anti-excitatory
      - Pulmonary vasodilators
Leading causes of global mortality

Impact of respiratory illness on global mortality

Global deaths due to acute respiratory infections

Yearly prevalence (in 000s) of acute respiratory infections (ARI), by WHO region

Deaths due to ARI, by WHO region

Deaths due to ARI, by age and sex, worldwide

WHO, World Health Report, 2004
Notice of Prevnar Price Increase

Effective 9/25/04, Wyeth Pharmaceuticals will charge $326 for a 5 dose package (an increase of $5 per dose) of Prevnar (CPT 90669 pneumococcal conjugate vaccine, for children under 5 years, for intramuscular use).

American Academy of Pediatrics website

Influenza

- Roughly 20% of children and 5% of adults develop symptomatic influenza infections each year
- Infection is continuous in tropics, seasonal elsewhere
- Three types of influenza virus: A, B, C
- Only types A and B cause outbreaks
- Two major surface proteins:
  - Hemagglutinin: facilitates entry into host cells through sialic acid receptors
  - Neuraminidase: catalyzes cleavage of glycosidic linkages to sialic acid and assists in release of progeny virions from infected cells; drug target
- Influenza A:
  - 15 hemagglutinin subtypes
  - 9 neuraminidase subtypes

Natural hosts of influenza viruses

At present, only H1N1 and H3N2 are in circulation among humans
Pandemic influenza

- Caused by sudden appearance of a new subtype: antigenic drift
- 1918-1919
  - H1N1 “Spanish flu”
  - Arose in swine (?)
  - 20 million deaths in first year; 50 million deaths total
- 1957-1958
  - H2N2 “Asian flu”
  - Arose in fowl
  - Severe pandemic; 70,000 deaths in U.S.
- 1968-1969
  - H3N2 “Hong Kong flu”
  - Arose in fowl
  - Moderately severe; 34,000 deaths in the U.S.

- Future pandemics:
  - H5N1 (“Avian flu”)
  - H7N7
  - Both are highly lethal, though little if any person-to-person transmission yet documented

Strategies for controlling influenza

- Surveillance
- Vaccination
- Treatment

Leading causes of death in the U.S., 1980 and 2004

<table>
<thead>
<tr>
<th>1980</th>
<th>1997</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart disease</td>
<td>Heart disease</td>
</tr>
<tr>
<td>Cancer</td>
<td>Cancer</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>Cerebrovascular disease</td>
</tr>
<tr>
<td>Unintentional injuries</td>
<td>Unintentional injuries</td>
</tr>
<tr>
<td>COPD</td>
<td>Diabetes</td>
</tr>
<tr>
<td>Pneumonia and influenza</td>
<td>Alzheimer’s Disease</td>
</tr>
<tr>
<td>Diabetes</td>
<td>Pneumonia and influenza</td>
</tr>
<tr>
<td>Chronic liver disease</td>
<td>Renal disease</td>
</tr>
<tr>
<td>Atherosclerosis</td>
<td>Sepsis</td>
</tr>
<tr>
<td>Suicide</td>
<td></td>
</tr>
</tbody>
</table>

Deaths due to pneumonia and influenza, U.S., by year and sex

Source: National Center for Health Statistics

Age-specific mortality for ARI, US, 2001

Source: National Center for Health Statistics
Risk factors for community acquired pneumonia

- Advancing age
- Tobacco use
- Air pollution
- Underlying chronic disease
- Malnutrition
- Alcohol use
- Chronic obstructive pulmonary disease
- Others including immunodeficiency, treatment with immunosuppressive drugs, malignancy, etc.

Influenza vaccine coverage, United States, 2004-2005

Pneumococcal vaccine coverage in persons > 65 years, U.S., 1997-2005

Global tobacco-related mortality, 2002-2030

Tobacco-related deaths annually, U.S.

U.S. smoking trends

Source: CDC, National Center for Chronic Disease Prevention and Health Promotion, 2002
Percentage of High School Students Who Reported Lifetime Cigarette Use,* by Sex** and Race/Ethnicity, 2005

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>Total</th>
<th>Female</th>
<th>Male</th>
<th>White</th>
<th>Black</th>
<th>Hispanic</th>
</tr>
</thead>
<tbody>
<tr>
<td>为中国</td>
<td>55.9</td>
<td>54.0</td>
<td>54.7</td>
<td>57.1</td>
<td>54.3</td>
<td>52.7</td>
</tr>
</tbody>
</table>

Percentage of High School Students Who Reported Current Cigarette Use,* by Sex and Race/Ethnicity,** 2005

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>Total</th>
<th>Female</th>
<th>Male</th>
<th>White</th>
<th>Black</th>
<th>Hispanic</th>
</tr>
</thead>
<tbody>
<tr>
<td>为中国</td>
<td>22.9</td>
<td>25.9</td>
<td>12.9</td>
<td>22.0</td>
<td>23.0</td>
<td>23.0</td>
</tr>
</tbody>
</table>

Philip Morris Co. memorandum, March 31, 1981

RJR
July 18, 1980
Limiting morbidity and mortality from tobacco use

- Medical model
  - Smoking cessation
  - Early detection and treatment of smoking-related illness:
    - Lung cancer screening
    - Prevention and treatment of COPD

- Public health model
  - Limiting access to tobacco
  - Raising cigarette tax
  - Enforcing age limits for purchase
  - Smoking restrictions in workplaces and public facilities
  - Discouraging use of tobacco
    - School-based initiatives
    - Counter-advertising

Hutchinson Smoking Prevention Project: Long-Term Randomized Trial of School-Based Tobacco Use Prevention

- 40 school districts in Washington State randomized to provide comprehensive anti-tobacco curriculum (based on CDC and NCI recommendations) in grades 3-12 or standard health curriculum
- Main study endpoints were smoking in grade 12 and 2 years after high school
- 8388 students entering third grade were subjects in the study; follow-up data available on 93%
- Prevalence of daily smoking at study conclusion:
  - 24.66% in control districts
  - 24.41% in experimental districts


Figure 10: Success rates for various cessation methods, 1998

Figure 11: Percentage of current smokers aged 12 years who purchased cigarettes in a store and were not asked to show proof of age or who were not refused purchase because of their age, 2009

Secondhand smoke kills.
Smoke-Free Workplace Act of 2002 (NYC Local Law 47)

- Law took effect March 30, 2003
- Bans smoking in all indoor workplaces in New York City, including bars and restaurants of any size.
- Exemptions for 7 currently existing cigar bars.
- Exemptions for owner operated bars.
- Restaurants will be allowed to build completely enclosed, negative pressure ventilated smoking rooms into which no employee will be allowed until the last customer of the day has left. Clause sunsets after three years.
- New York State has adopted a similar law that covers the entire state.

The New York Times

Legislators Pass Smoking Ban in New Jersey

By RICHARD LEZIN JONES and JOSH BENSON
Published: January 10, 2006

TRENTON, Jan. 9 - New Jersey lawmakers approved a far-reaching ban Monday on smoking in indoor public places that includes virtually all of the state's bars and restaurants but not the gambling areas of Atlantic City's 12 casinos.
U.S. asthma discharges, 1970-1997

National Center for Health Statistics, National Hospital Discharge Survey