“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
  - Work of breathing
  - Compliance
  - Resistance
  - $P_{aw}-P_{aw}/flow$
  - PEEP and Auto-PEEP

II
- Understand gas exchange in health and disease
  - Alveolar air equation and calculation of alveolar-arterial (A-a) gradient
  - $P_{aw}=P_{aw}-P_{sat}$
  - Oxygen delivery to tissues
  - Oxygenation dissociation curve
  - $DO_2+COXCO_2$
  - $CaO_2=(Hgb \times 1.39 \times 1.24)+(pO_2 \times 0.038)$
  - Mechanisms of hypoxemia
  - Shunt
  - Corrects with oxygen breathing
  - V/Q mismatch
  - Corrects with oxygen breathing
  - Exacerbated by exercise
  - Alveolar hypoventilation
  - Normal A-a gradient
  - Corrects with oxygen breathing
  - Diffusion limitation
  - Corrects with oxygen breathing
  - Exacerbated by exercise

III
- Understand symptoms and signs of pulmonary disease
  - Symptoms
  - Dyspnea
  - Onset
  - Severity
  - Triggers
  - 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

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-neoplastics
    - Pulmonary vasodilators
Leading causes of global mortality

WHO, World Health Report, 2004

Impact of respiratory illness on global mortality

WHO, World Health Report, 2004

Global deaths due to acute respiratory infections

Source: WHO Global Disease Burden Report

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

Source: WHO Global Disease Burden Report

Deaths due to ARI, by WHO region

Source: WHO Global Disease Burden Report

Deaths due to ARI, by age and sex, worldwide

Source: WHO Global Disease Burden Report
Cause of death among children less than 5 years of age

<table>
<thead>
<tr>
<th>Cause of Death</th>
<th>Africa</th>
<th>Global</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute respiratory infection</td>
<td>16</td>
<td>18</td>
</tr>
<tr>
<td>Diarrheal disease</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>Malaria</td>
<td>22</td>
<td>10</td>
</tr>
<tr>
<td>Measles</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>HIV or AIDS</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Neonatal deaths</td>
<td>13</td>
<td>23</td>
</tr>
<tr>
<td>Other causes</td>
<td>19</td>
<td>25</td>
</tr>
<tr>
<td>All causes</td>
<td>4.5 million</td>
<td>10.9 million</td>
</tr>
</tbody>
</table>

Source: NEJM, WHO

Serotypes of S. pneumoniae and H. influenzae in bacteremia-related isolates from Kenya

- **S. pneumoniae** serotypes
  - 1 (66 patients)**
  - 14 (39 patients)*
  - 6A (26 patients)*
  - 6B (24 patients)*
  - 23F (21 patients)*
  - 18C (13 patients)*
  - 4 (11 patients)*
  - 3 (10 patients)*
  - 19F (10 patients)*

- **H. influenzae**
  - 113/136 (83%) type B

*Serotype included in commercially available 7-valent conjugate pneumococcal vaccine
**Serotype included in 9-valent conjugate pneumococcal vaccine

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
Pandemic influenza

- Caused by sudden appearance of a new subtype: antigenic shift
- 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 1997

<table>
<thead>
<tr>
<th>1980</th>
<th>1997</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Heart disease</td>
<td>1. Heart disease</td>
</tr>
<tr>
<td>2. Cancer</td>
<td>2. Cancer</td>
</tr>
<tr>
<td>3. Cerebrovascular disease</td>
<td>3. Cerebrovascular disease</td>
</tr>
<tr>
<td>4. Unintentional injuries</td>
<td>4. COPD</td>
</tr>
<tr>
<td>5. COPD</td>
<td>5. Unintentional injuries</td>
</tr>
<tr>
<td>6. Pneumonia and influenza</td>
<td>6. Pneumonia and influenza</td>
</tr>
<tr>
<td>7. Diabetes</td>
<td>7. Diabetes</td>
</tr>
<tr>
<td>8. Chronic liver disease</td>
<td>8. Suicide</td>
</tr>
<tr>
<td>10. Suicide</td>
<td>10. Chronic liver disease</td>
</tr>
</tbody>
</table>
Deaths due to pneumonia and influenza, U.S., by year and sex

Age-specific mortality for ARI, US, 2001

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.

- Lung and Bronchus (31%)
- Prostate (16%)
- Colon and Rectum (10%)
- Pancreas (5%)
- Non-Hodgkin Lymphoma (4%)
- Leukemia (4%)
- Esophagus (4%)
- Liver (3%)
- Urinary Bladder (3%)
- Kidney (3%)
- All Other Sites (22%)


- Lung and Bronchus (25%)
- Breast (15%)
- Colon and Rectum (11%)
- Pancreas (6%)
- Ovary (5%)
- Non-Hodgkin Lymphoma (4%)
- Leukemia (4%)
- Uterine Corpus (3%)
- Brain (2%)
- Multiple Myeloma (2%)
- All Other Sites (23%)

National Center for Health Statistics
Tobacco-related deaths annually, U.S.

Source: CDC, ALA

Smoking prevalence in Europe: men

Source: World Health Organization

Smoking prevalence in Europe: women

Source: World Health Organization

Current smokers: nationwide - grouped by gender

Source: CDC, National Center for Chronic Disease Prevention and Health Promotion, 2002

Current smokers: nationwide - grouped by age

Source: CDC, National Center for Chronic Disease Prevention and Health Promotion, 2002
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

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.

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.