“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 of efficiency of ventilation)
    - Work of breathing
    - Compliance
      - $\Delta V/\Delta P$
    - Resistance
      - $P_{alv} - P_{mouth}/flow$
    - PEEP and Auto-PEEP

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
    - $P_{A\text{O}_2} = P_{I\text{O}_2} - (P_{CO_2}/R)$
  - Oxygen delivery to tissues
    - Oxyhemoglobin dissociation curve
    - $DO_2 = CO \times CaO_2$
    - $CaO_2 = ([Hgb] \times 1.39 \times %sat) + (pO_2 \times .0036)$
  - Mechanisms of hypoxemia
    - Shunt
      - Does not correct 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
Goals and objectives for the pulmonary section: 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

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-neoplastics
      – Pulmonary vasodilators
Leading causes of global mortality

- Ischemic heart disease
- Cerebrovascular disease
- Acute lower respiratory tract infections
- HIV/AIDS
- COPD
- Diarrheal diseases
- Perinatal mortality
- Tuberculosis
- Cancer of the respiratory tree
- Road traffic accidents

WHO, World Health Report, 2004

Leading causes of death in the world

- 2004
  - Ischemic heart disease
  - Cerebrovascular disease
  - Acute lower respiratory tract infections
  - HIV/AIDS
  - COPD
  - Diarrheal diseases
  - Perinatal mortality
  - Tuberculosis
  - Cancer of the respiratory tree
  - Road traffic accidents

- 2030
  - Ischemic heart disease
  - Cerebrovascular disease
  - Acute lower respiratory tract infections
  - Cancer of the respiratory tree
  - Diabetes mellitus
  - Perinatal mortality
  - Stomach cancer

Mathers, PLOS Medicine 2006; 3: e442
Impact of respiratory illness on global mortality

respiratory illnesses account for 8.43 million deaths per year, or 15.7% of total deaths in WHO member nations.

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

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></td>
<td>percent</td>
<td></td>
</tr>
<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>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>number</th>
</tr>
</thead>
<tbody>
<tr>
<td>All causes</td>
<td>4.5 million</td>
</tr>
</tbody>
</table>

Source: NEJM, WHO
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 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 2004

<table>
<thead>
<tr>
<th>1980</th>
<th>2004</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. Diabetes</td>
</tr>
<tr>
<td>7. Diabetes</td>
<td>7. Alzheimer’s Disease</td>
</tr>
<tr>
<td>8. Chronic liver disease</td>
<td>8. Pneumonia and influenza</td>
</tr>
<tr>
<td>10. Suicide</td>
<td>10. Sepsis</td>
</tr>
</tbody>
</table>

National Center for Health Statistics
Deaths due to pneumonia and influenza, U.S., by year and sex

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.

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

CDC, 2006
Influenza vaccine coverage, United States, 2004-2005

![Graph showing influenza vaccine coverage among priority populations by month.](image)


![Graph showing trends in age-standardized death rates for various causes of death.](image)

2007 Estimated US Cancer Deaths*

<table>
<thead>
<tr>
<th>Cancers</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung &amp; bronchus</td>
<td>31%</td>
<td>26%</td>
</tr>
<tr>
<td>Prostate</td>
<td>9%</td>
<td>15%</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>9%</td>
<td>10%</td>
</tr>
<tr>
<td>Pancreas</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>Leukemia</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>Liver &amp; intrahepatic bile duct</td>
<td>4%</td>
<td>3%</td>
</tr>
<tr>
<td>Esophagus</td>
<td>4%</td>
<td>3%</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>3%</td>
<td>2%</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Kidney</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>All other sites</td>
<td>24%</td>
<td>23%</td>
</tr>
</tbody>
</table>

*Includes both cutaneous and in situ skin cancer.

ONS=Other nervous system.

Source: American Cancer Society, 2007
Age-Adjusted Cancer Death Rates,* Males by Site, US, 1930-2002

Rate per 100,000 male population

- Lung & bronchus
- Stomach
- Prostate
- Colon & rectum
- Leukemia
- Liver
- Pancreas

*Per 100,000, age-adjusted to the 2000 US standard population.

Note: Due to changes in ICD coding, numerator information has changed over time. Rates for cancer of the liver, lung and bronchus, and colon and rectum are affected by these coding changes.


American Cancer Society, Surveillance Research, 2006

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Age-Adjusted Cancer Death Rates,* Females by Site, US, 1930-2002

Rate per 100,000 female population

- Uterus*
- Breast
- Lung & bronchus
- Stomach
- Colon & rectum
- Ovary
- Pancreas

*Per 100,000, age-adjusted to the 2000 US standard population. Uterus cancer death rates are for uterine cervix and uterine corpus combined.

Note: Due to changes in ICD coding, numerator information has changed over time. Rates for cancer of the lung and bronchus, colon and rectum, and ovary are affected by these coding changes.


American Cancer Society, Surveillance Research, 2006
Global tobacco-related mortality, 2002-2030

Tobacco-related deaths annually, U.S.

Source: CDC, ALA
Smoking trends, United States, 1965-2006

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

* Ever tried cigarette smoking, even one or two puffs
** M > F

National Youth Risk Behavior Survey, 2005
Percentage of High School Students Who Reported Current Cigarette Use,* by Sex and Race/Ethnicity,** 2005

* Smoked cigarettes on ≥ 1 of the 30 days preceding the survey
** W, H > B

National Youth Risk Behavior Survey, 2005
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

PERCENTAGE OF CURRENT SMOKERS AGED <18 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, 2000

![Bar chart showing percentage of current smokers aged <18 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, 2000.](chart.png)

**Source:** National Youth Tobacco Survey, 2000

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You've got 6 months to live.

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Legacy
THERE’S NO SUCH THING AS A NON-SMOKING SECTION

Just 20 minutes of exposure to secondhand smoke increases the risk of heart disease. In non-smokers, 6 teenagers who work a 6-hour shift in a smoke-free workplace have the same amount of concerning cholesterol as if they’d smoked more than half a pack of cigarettes.

Second-hand smoke kills.
For more information, call the New York State Healthline at 1-800-440-4311.

New York City Department of Health and Mental Hygiene
Edward G. McCaffrey, MD - Commissioner
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.
Workplace smoking ban, Ireland

from McElvaney NG. NEJM 2004; 2231-2234
NEW! Omni
Reduced carcinogens. Premium taste.
We believe every smoker deserves both.

www.omnihogs.com