“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
    • Work of breathing
    • Compliance
      – \( \Delta V/\Delta P \)
    • Resistance
      – \( P_{\text{alv}} - P_{\text{mean}}/\text{flow} \)
  • 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
    – \( P_{\text{A}O_2} = P_{\text{alv}O_2} - (P_{\text{CO}_2}/R) \)
  – Oxygen delivery to tissues
    • Oxyhemoglobin dissociation curve
    • \( DO_2 = CO \times CaO_2 \)
    • \( CaO_2 = ([Hgb] \times 1.39 \times \%\text{sat}) + (pO_2 \times 0.0036) \)
  – 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

<table>
<thead>
<tr>
<th>Disease</th>
<th>Deaths (in millions)</th>
<th>% of all deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ischemic heart disease</td>
<td>7.4</td>
<td>14</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>2.1</td>
<td>4</td>
</tr>
<tr>
<td>Acute LRI</td>
<td>6.4</td>
<td>12</td>
</tr>
<tr>
<td>HIV/AIDS</td>
<td>6.0</td>
<td>12</td>
</tr>
<tr>
<td>COPD</td>
<td>2.8</td>
<td>5</td>
</tr>
<tr>
<td>Diarrheal diseases</td>
<td>1.8</td>
<td>3</td>
</tr>
<tr>
<td>Perinatal conditions</td>
<td>1.4</td>
<td>2</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>1.0</td>
<td>2</td>
</tr>
<tr>
<td>Cancer of respiratory tree</td>
<td>1.2</td>
<td>2</td>
</tr>
<tr>
<td>Road traffic accidents</td>
<td>0.6</td>
<td>1</td>
</tr>
</tbody>
</table>

WHO, World Health Report, 2004

Impact of respiratory illness on global mortality

Lung diseases 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

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

Overall, 298/398 (75%) isolates were of serotypes covered by vaccines

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
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>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. 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

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**Leading causes of death for all ages**

[Sources: Centers for Disease Control and Prevention, National Center for Health Statistics, Health, United States, 2006, Figure 27. Data from the National Vital Statistics System.]
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 vaccination in past year, 2003-04

SOURCES: Centers for Disease Control and Prevention, National Center for Health Statistics, /Health, United States, 2006, Figure 20. Data from the National Health Interview Survey.
Influenza vaccine coverage, United States, 2004-2005

FIGURE. Monthly influenza vaccination coverage among selected priority populations, by month — Behavioral Risk Factor Surveillance System, United States, 2004-05 influenza season.

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

MMWR 2005; 54: 304-307

CDC, 2006


Leading Sites of New Cancer Cases and Deaths – 2006 Estimates

<table>
<thead>
<tr>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated New Cases*</td>
<td>Estimated Deaths</td>
</tr>
<tr>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Prostate 234,460 (33%)</td>
<td>Breast 212,929 (31%)</td>
</tr>
<tr>
<td>Lung &amp; bronchus 93,760 (12%)</td>
<td>Lung &amp; bronchus 81,700 (12%)</td>
</tr>
<tr>
<td>Colon &amp; rectum 72,880 (10%)</td>
<td>Colon &amp; rectum 75,810 (11%)</td>
</tr>
<tr>
<td>Urinary bladder 44,680 (6%)</td>
<td>Uterine corpus 41,200 (6%)</td>
</tr>
<tr>
<td>Malignoma of the skin 34,260 (5%)</td>
<td>Non-Hodgkin lymphoma 28,190 (4%)</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma 30,680 (4%)</td>
<td>Malignoma of the skin 27,690 (4%)</td>
</tr>
<tr>
<td>Kidney &amp; renal pelvis 24,650 (3%)</td>
<td>Thyroid 22,550 (3%)</td>
</tr>
<tr>
<td>Oral cavity &amp; pharynx 20,180 (3%)</td>
<td>Ovary 20,180 (3%)</td>
</tr>
<tr>
<td>Leukemia 20,060 (3%)</td>
<td>Urinary bladder 16,750 (2%)</td>
</tr>
<tr>
<td>Pancreas 17,150 (2%)</td>
<td>Pancreas 16,580 (2%)</td>
</tr>
<tr>
<td>All sites 720,280 (100%)</td>
<td>All sites 679,310 (100%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung &amp; bronchus 90,339 (31%)</td>
<td>Breast 72,130 (26%)</td>
</tr>
<tr>
<td>Colon &amp; rectum 27,879 (10%)</td>
<td>Colon &amp; rectum 27,300 (10%)</td>
</tr>
<tr>
<td>Prostate 27,350 (9%)</td>
<td>Pancreas 16,210 (6%)</td>
</tr>
<tr>
<td>Ovary 12,470 (4%)</td>
<td>Leukemia 15,310 (6%)</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma 10,840 (4%)</td>
<td>Lung &amp; bronchus 10,530 (4%)</td>
</tr>
<tr>
<td>Eosinophilic leukemia 10,000 (3%)</td>
<td>Uterine corpus 7,350 (3%)</td>
</tr>
<tr>
<td>Leukemia 9,810 (4%)</td>
<td>Multiple myeloma 5,650 (2%)</td>
</tr>
<tr>
<td>Pancreas 9,690 (3%)</td>
<td>Brain &amp; other nervous system 5,560 (2%)</td>
</tr>
<tr>
<td>Kidney &amp; renal pelvis 8,130 (3%)</td>
<td>All sites 273,560 (100%)</td>
</tr>
<tr>
<td>All sites 293,210 (100%)</td>
<td>All sites 273,560 (100%)</td>
</tr>
</tbody>
</table>

*Includes basal and squamous cell skin cancers and in situ carcinoma except urinary bladder.
Note: Percentages may not total 100% due to rounding.

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

- 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

- Uterus
- Breast
- Lung & Bronchus
- Stomach
- Colon & Rectum
- Ovary
- Pancreas

*Per 100,000, age-adjusted to the 2000 US standard population. Uterine 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
U.S. smoking trends

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

Male Smoking

Smoking has been proven to be a major killer, leading to serious health issues such as heart disease, lung cancer, stroke, and overall reduced life expectancy. Smoking is a leading cause of preventable death and disability worldwide.

Challenges related to smoking and tobacco control include creating awareness, enforcing laws, and implementing policies to reduce smoking rates.

Smoking prevalence for men

- Smoking among men aged 15 and over
- Male smoking rates vary significantly across countries and regions.

Smoking trends from 2000 to 2018 show a decrease in smoking rates in many countries, reflecting increased awareness and efforts to reduce smoking.
Female Smoking

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

National Youth Risk Behavior Survey, 2005

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

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

National Youth Risk Behavior Survey, 2005

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

It is important to know as much as possible about teenage smoking patterns and attitudes. Today's teenager is tomorrow's potential regular customer, and the overwhelming majority of smokers first begin to smoke while still in their teens. In addition, the ten years following the teenage years is the period

Because of our high share of the market among the youngest smokers, Philip Morris will suffer more than the other companies from the decline in the number of teenage smokers. For at least the next decade, however, the population trends will have a much more powerful influence, and in this regard we want to appear to be the least vulnerable of all the companies, as will be discussed later in this report.

Philip Morris Co. memorandum, March 31, 1981
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

---

**FIGURE 10: SUCCESS RATES FOR VARIOUS CESSATION METHODS, 1998**

<table>
<thead>
<tr>
<th>Method</th>
<th>Percentage of Success</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self Help Only</td>
<td>4.0</td>
</tr>
<tr>
<td>Patch</td>
<td>8.0</td>
</tr>
<tr>
<td>Gum</td>
<td>14.0</td>
</tr>
<tr>
<td>Behavioral</td>
<td>15.0</td>
</tr>
<tr>
<td>Inhalers</td>
<td>19.0</td>
</tr>
<tr>
<td>Nicorette + Bhr</td>
<td>27.5</td>
</tr>
<tr>
<td>Prescriptions</td>
<td>28.0</td>
</tr>
<tr>
<td>Nasal Spray</td>
<td>30.0</td>
</tr>
</tbody>
</table>

Source: CDC Office on Smoking & Health - Cessation Division
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

SOURCE: NATIONAL YOUTH TOBACCO SURVEY, 2000
THERE'S NO SUCH THING AS A NON-SMOKING SECTION

Just 20 minutes of exposure to second-hand smoke increases the risk of heart disease in non-smokers. Bartenders who work an 8-hour shift in a smoky bar inhale the same amount of oncogenic chemicals as if they'd smoked more than half a pack of cigarettes.

Second-hand smoke kills.
For more information, call the New York Smokers’ Helpline at 1-800-695-0511.

New York City Department of Health and Mental Hygiene
Ronald Polonsky, M.D. - Deputy Commissioner, N.H., C.M., Commissioner

Total Cigarette Sales and Cigarette Prices, 1970-2000

APHA, 2002
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.

Workplace smoking ban, Ireland

from McEvany NG. NEJM 2004; 2231-2234
U.S. asthma discharges, 1970-1997

National Center for Health Statistics, National Hospital Discharge Survey