Tobacco Use as a Chronic Disease
Learning Objectives

• Select strategies that have decreased smoking consumption at a population level
• Recognize causes of tobacco-related death
• Identify the properties of carbon monoxide (MO)
• Select the Diagnostic and Statistical Manual’s (DSM 5) list of tobacco withdrawal symptoms
• Recall which diseases reverse with smoking cessation
Disclosures

Relevant Financial Relationship(s)

<table>
<thead>
<tr>
<th>Name</th>
<th>Nature of Relationship</th>
<th>Company Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jon Ebbert, M.D.</td>
<td>Consultant</td>
<td>Nesmah</td>
</tr>
<tr>
<td></td>
<td>Stock Shareholder (self-managed)</td>
<td>Al Kaif</td>
</tr>
</tbody>
</table>

Off Label/Investigational Usage

None
Figure 8.1. Prevalence of current cigarette smoking among adults aged 18 and over: United States, 1997–September 2017

Percent

NOTES: Data are based on household interviews of a sample of the civilian noninstitutionalized population. Current cigarette smokers were defined as those who had smoked more than 100 cigarettes in their lifetime and now smoke every day or some days. The analyses exclude persons with unknown cigarette smoking status (about 2% of respondents each year). See Technical Notes for more details.


- For January–September 2017, the percentage of adults aged 18 and over who were current cigarette smokers was 14.1% (95% confidence interval = 13.52%–14.74%), which was lower than the 2016 estimate of 15.8%.
Figure 19. Daily Cigarette Use among Past Month Cigarette Smokers Aged 12 or Older and Smoking of One or More Packs of Cigarettes per Day among Current Daily Smokers: Percentages, 2014

- 22.8 Million Less Than Daily Smokers (41.2%)
- 32.5 Million Daily Smokers (58.8%)
- 19.3 Million Smokers of Less Than a Pack per Day (59.7%)
- 13.1 Million Smokers of One or More Packs per Day (40.3%)

Note: Current daily smokers with unknown data about the number of cigarettes smoked per day were excluded.
Percentage of Cigarette Smokers Per State


Note: Data is from 2012.
Carcinogenicity of Tobacco Smoke

• Cigarette smoking is the single largest preventable cause of death and disability in developed countries

• Tobacco smoke contains more than 4000 chemicals

• More than 60 carcinogens are in cigarette smoke, and a minimum of 16 are in unburned tobacco

• The composition of the processed tobacco in cigarettes influences the chemistry and toxicity of the smoke

Surgeon General’s Report, 1989
28 Known Carcinogens in ST

- **Including**…..
  - β-Angelica lactone
  - Coumarin
  - Ethyl carbamate (urethane)
  - Formaldehyde
  - Acetaldehyde
  - Crotonaldehyde

- Tobacco-specific N-nitrosamines (TSNA)
  - $N'$-Nitrosonornicotine (NNN)
  - 4-(Methylnitrosamino)-1-(3-pyridyl)-1-butanone (NNK)
  - 4-(Methylnitrosamino)-1-(3-pyridyl)-1-butanol (NNAL)
  - $N'$-Nitrosoanabasine (NAB)

- Arsenic
- Nickel compounds
- Polonium-210
- Uranium-235
- Uranium-238

Per Capita Consumption of Tobacco in the United States, 1880-1995

Source: Burns et al., via U.S. Department of Agriculture, Vox
480,000 people =

Every day for an entire year…. With no survivors.
Annual Deaths from Smoking, United States

Lung Cancer
137,989 (29%)

Heart Disease
158,750 (33%)

More Than
480,000
US Deaths
Every Year
Are From
Cigarette Smoking

Other Cancers
36,000 (7%)

Other Diagnoses
31,681 (7%)

Stroke
15,300 (3%)

Note: Average annual number of deaths for adults aged 35 or older, 2005-2009.
Decreases in Cigarette Consumption at Population Level

• Price increases
• Clean indoor air legislation
• 1964 Surgeon General’s Report on the Health Consequences of Smoking
Cigarette Smoking & Chronic Disease
Risks of Cigarette Smoking

- Cancer
- Cardiovascular Disease
- Lung Disease
- Reproductive effects
### Figure 3. Leading Sites of New Cancer Cases and Deaths – 2019 Estimates

**Estimated New Cases**

<table>
<thead>
<tr>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prostate</td>
<td>Breast</td>
</tr>
<tr>
<td>174,650 20%</td>
<td>268,600 30%</td>
</tr>
<tr>
<td>Lung &amp; bronchus</td>
<td>Lung &amp; bronchus</td>
</tr>
<tr>
<td>116,440 13%</td>
<td>111,710 13%</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>Colon &amp; rectum</td>
</tr>
<tr>
<td>78,500 9%</td>
<td>67,100 7%</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>Uterine corpus</td>
</tr>
<tr>
<td>61,700 7%</td>
<td>61,880 7%</td>
</tr>
<tr>
<td>Melanoma of the skin</td>
<td>Melanoma of the skin</td>
</tr>
<tr>
<td>57,220 7%</td>
<td>39,260 5%</td>
</tr>
<tr>
<td>Kidney &amp; renal pelvis</td>
<td>Thyroid</td>
</tr>
<tr>
<td>44,120 5%</td>
<td>37,810 4%</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>Non-Hodgkin lymphoma</td>
</tr>
<tr>
<td>41,090 5%</td>
<td>33,110 4%</td>
</tr>
<tr>
<td>Oral cavity &amp; pharynx</td>
<td>Kidney &amp; renal pelvis</td>
</tr>
<tr>
<td>38,140 4%</td>
<td>29,700 3%</td>
</tr>
<tr>
<td>Leukemia</td>
<td>Pancreas</td>
</tr>
<tr>
<td>35,920 4%</td>
<td>26,830 3%</td>
</tr>
<tr>
<td>Pancreas</td>
<td>Leukemia</td>
</tr>
<tr>
<td>29,940 3%</td>
<td>25,860 3%</td>
</tr>
<tr>
<td><strong>All sites</strong></td>
<td><strong>All sites</strong></td>
</tr>
<tr>
<td><strong>870,970</strong></td>
<td><strong>891,480</strong></td>
</tr>
</tbody>
</table>

**Estimated Deaths**

<table>
<thead>
<tr>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lung &amp; bronchus</td>
<td>Lung &amp; bronchus</td>
</tr>
<tr>
<td>76,650 24%</td>
<td>66,020 23%</td>
</tr>
<tr>
<td>Prostate</td>
<td>Breast</td>
</tr>
<tr>
<td>31,620 10%</td>
<td>41,760 15%</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>Colon &amp; rectum</td>
</tr>
<tr>
<td>27,640 9%</td>
<td>23,380 8%</td>
</tr>
<tr>
<td>Pancreas</td>
<td>Pancreas</td>
</tr>
<tr>
<td>23,800 7%</td>
<td>21,950 8%</td>
</tr>
<tr>
<td>Liver &amp; intrahepatic bile duct</td>
<td>Ovary</td>
</tr>
<tr>
<td>21,600 7%</td>
<td>13,980 5%</td>
</tr>
<tr>
<td>Leukemia</td>
<td>Uterine corpus</td>
</tr>
<tr>
<td>13,150 4%</td>
<td>12,160 4%</td>
</tr>
<tr>
<td>Esophagus</td>
<td>Liver &amp; intrahepatic bile duct</td>
</tr>
<tr>
<td>13,020 4%</td>
<td>10,180 4%</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>Non-Hodgkin lymphoma</td>
</tr>
<tr>
<td>12,870 4%</td>
<td>8,460 3%</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>Brain &amp; other nervous system</td>
</tr>
<tr>
<td>11,510 4%</td>
<td>7,850 3%</td>
</tr>
<tr>
<td>Brain &amp; other nervous system</td>
<td>All sites</td>
</tr>
<tr>
<td>9,910 3%</td>
<td><strong>285,210</strong></td>
</tr>
</tbody>
</table>

*Estimates are rounded to the nearest 10, and cases exclude basal cell and squamous cell skin cancers and in situ carcinoma except urinary bladder. Estimates do not include Puerto Rico or other US territories. Ranking is based on modeled projections and may differ from the most recent observed data.*

©2019, American Cancer Society, Inc., Surveillance Research
Smoking and Lung Cancer

- Responsible for 90% of lung cancers
  - Smokers have 10-25X greater risk of lung cancer than nonsmokers
  - Five year survival is 14%
Risk of Lung Cancer

- The risk of developing lung cancer is directly related to the amount smoked

Pack/year was calculated by multiplying the average number of cigarettes smoked daily by the number of years smoked and dividing the product by 20.

*aThe relative likelihood of experiencing a particular event or the effect of an explanatory variable on the hazard or risk of an event.

Cigarette Smoking & Other Cancers

- Increases the risk for:
  - Lip
  - Oral cavity and pharynx
  - Esophagus
  - Pancreas
  - Larynx (voice box)
  - Uterine cervix
  - Urinary bladder
  - Kidney

Cigarette Smoking & Cardiovascular Disease

- Leading cause of death in USA
- Cigarette smokers are 2–4 times more likely to develop coronary heart disease than nonsmokers
- Smokers are more than 10 x as likely as nonsmokers to develop peripheral vascular disease

CDC Fact Sheet, February 2004.
SMOKING AND STROKE

Adapted from Lancet 2010; doi:10.1016/S0140-6736(10)60834-3
Chronic Obstructive Pulmonary Disease

- 90% of COPD mortality due to smoking
- Death rate for COPD 10 times higher among current smokers

CDC Fact
COPD: Pathology of Emphysema

Section of lung with both panacinar panlobular and centrilobular emphysema

Increased Rate of Decline in $\text{FEV}_1^a$ in Smokers

- Susceptible smokers develop significant lung function decline.

FEV$_1$ (Percentage of Value at Age 25)

Age (years)

- Never smoked or not susceptible to smoke
- Stopped at 50 years
- Stopped at 65 years
- Smoked regularly and susceptible to effects of smoking
- GOLD 0+1
- GOLD 2
- GOLD 3
- GOLD 4

Disability
Death

$^a$FEV$_1$ = volume of air that can be expired in 1 second. $^b$GOLD (Global Initiative for Chronic Obstructive Lung Disease) classification of severity of COPD.

Reproductive Effects

- Increases risk for:
  - Infertility
  - Preterm delivery
  - Stillbirth
  - Low birth weight
  - Sudden infant death syndrome (SIDS)

Smoking and Cognition

“Compared with never smokers, middle-aged male smokers are likely to experience faster 10-year cognitive decline.”

Sabia et al. Arch Gen Psychiatry Published online February 6, 2012.
Skin Effects of Smoking: Free Radicals

- Tobacco smoke contains $>10^{14}$ free radicals/puff
- Free radicals are toxic and highly reactive molecules
  - Deplete antioxidants
  - Promote carcinogenic transformation
  - Damage protein & lipids
  - Alter enzyme activity, membrane receptors, and protein transporters

52 Y/O Twins

Abdominal Aortic Aneurysm

- 5% prevalence in older men who ever smoked
  - Linked to smoking in 80% of cases
- 13,000 deaths/year
- US Prev Task Force Rec- abd U/S for ever smoker men age 65-75
- Screening ↓ mortality by 43%
- Screening is cost effective

Smoking and Macular Degeneration

- Population-based longitudinal cohort (N=4926) of people age 43-84
- Eye examination every 5 years for 15 years
- Smokers had ↑ risk of age-related macular degeneration (OR 1.47; CI 1.09-1.99; p=0.01) and progression (OR 1.43; CI 1.05-1.94 p=0.02)

Smoking Impairs Wound and Bone Healing

- ↓ tissue perfusion → ↓ tissue oxygenation
- Impaired neutrophil function
- Adversely affects fibroblast and osteoblast function
Carbon Monoxide (CO)

- Smoking increases the CO content in blood
  - CO enters the blood from the lungs and combines with Hgb which blocks the blood's ability to carry oxygen to body cells
- Non-smoker = 0-8 parts per million (ppm)
- CO 1 ppd = 20 ppm
- CO 2 ppd = 40 ppm
- CO disappears **within 1-2 days** after stopping smoking
### Smokeless Tobacco Health Effects: Cancers - U.S. Data

<table>
<thead>
<tr>
<th>Location</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cancer, Mouth and Gum</td>
<td>11.2 (4.1-30.7)</td>
</tr>
<tr>
<td>Gum &amp; Buccal Mucosa</td>
<td>4.2 (2.6-6.7)</td>
</tr>
<tr>
<td>Larynx</td>
<td>7.3 (2.9-18.3)</td>
</tr>
<tr>
<td>Salivary gland</td>
<td>5.3 (1.2-23.4)</td>
</tr>
<tr>
<td>Kidney</td>
<td>4.0 (1.2-12.9)</td>
</tr>
<tr>
<td>Pancreatic</td>
<td>3.6 (1.0-12.8)</td>
</tr>
</tbody>
</table>

ST Health Effects: CV Disease

- CPS-II

- *Current ST use vs. never associated with death from:
  - All causes: HR 1.18 (95% CI: 1.08-1.29)
  - CHD: HR 1.26 (95% CI: 1.08-1.47)
  - Cerebrovascular dz: HR 1.40 (95% CI: 1.10-1.79)

- No difference between snuff and chewing tobacco
- Former use did not increase the risk of death in any category

*Multivariable-adjusted

ST - Oral Lesions

- Leukoplakia
- Oral cancer
- Dental disease
  - erosion of enamel
  - dental caries
- Periodontal Disease
  - gingival recession
  - soft tissue/hard tissue loss
  - gingivitis
Translating the “Chronic Disease” Model into Treatment
20 million smokers try to stop each year. . .

- 7.6% are successful

- 30% who try to quit relapse within 72 hours
Tobacco Dependence Is A Chronic Disease

- Identifiable etiology and pathophysiology
- Symptoms
- Characterized by relapses and remissions
- Spectrum of disease severity
- Effective treatments exist
- Variety of treatment options
- May require referral to specialists
- Individualized therapy is important
Tobacco Dependence Is A Chronic Disease

- Identifiable etiology and pathophysiology
- Symptoms
- Characterized by relapses and remissions
- Spectrum of disease severity
- Effective treatments exist
- Variety of treatment options
- May require referral to specialists
- Individualized therapy is important
Nicotine is a Why People Smoke Cigarettes

After inhaling, nicotine reaches the brain in 7-10 seconds

- “Euphoria” without being “stoned”
- Immediate reinforcement of drug-taking behavior
- Allow moment to moment titration of dose to achieve the desired effects
Rise in blood nicotine concentrations after smoking a cigarette and after using different NRT products (after overnight abstinence from cigarettes). Values are for venous blood, except where shown.

Adapted from Henningfield JE. N Engl J Med
Tobacco Dependence Is A Chronic Disease

- Identifiable etiology and pathophysiology
- Symptoms
- Characterized by relapses and remissions
- Spectrum of disease severity
- Effective treatments exist
- Variety of treatment options
- May require referral to specialists
- Individualized therapy is important
Withdrawal Symptoms (DSM-5)

- Irritability, frustration, or anger
- Anxiety
- Difficulty concentrating
- Increased appetite
- Restlessness
- Depressed mood
- Insomnia
Tobacco Dependence Is A Chronic Disease

- Identifiable etiology and pathophysiology
- Symptoms
- Characterized by relapses and remissions
- Spectrum of disease severity
- Effective treatments exist
- Variety of treatment options
- May require referral to specialists
- Individualized therapy is important
Rate of Relapse

Hunt et al., 1971
Abstinence & Relapse

- Variables with higher abstinence rates
  - High motivation
  - Ready to Change
  - Moderate to High Self-Efficacy
  - Supportive Social Network

- Variables with higher relapse rates
  - Length of previous abstinence: < 1 month
  - Unable to achieve target quit date
  - History of serious mental illness
  - History of substance abuse
Tobacco Dependence Is A Chronic Disease

• Identifiable etiology and pathophysiology
• Symptoms
• Characterized by relapses and remissions
• Spectrum of disease severity
• Effective treatments exist
• Variety of treatment options
• May require referral to specialists
• Individualized therapy is important
Indications of Higher Dependence

- Amount: > 20 cigarettes/day; > 3 tins/week
- Smokes/dips within 30 minutes of waking
- Withdrawal symptoms within hours of abstinence
Fagerström Test of Nicotine Dependence (FTND)

- Measures physical dependence to nicotine
- Correlated with biochemical measures of nicotine dependence (cotinine levels)
- Predicts smoking abstinence

Score:
- > 4 = Nicotine Dependence
- ≥ 6 = Severe Nicotine Dependence
Tobacco Dependence Is A Chronic Disease

- Identifiable etiology and pathophysiology
- Symptoms
- Characterized by relapses and remissions
- Spectrum of disease severity
- Effective treatments exist
- Variety of treatment options
- May require referral to specialists
- Individualized therapy is important
Basic Concepts

- Treat tobacco dependence for the serious medical problem it is
- Motivational counseling plus pharmacotherapy
- Dose response to counseling
- Pharmacotherapy
  - Tailored - not “one size fits all”
  - Combination therapy
  - Longer treatment duration
USPHS Clinical Practice Guideline
Pharmacotherapy

• First line
  • nicotine gum
  • nicotine patches
  • nicotine nasal spray
  • nicotine inhaler
  • nicotine lozenge
  • bupropion
  • varenicline

• Second line
  • clonidine
  • nortriptyline

www.ahrq.gov
Benefits of Quitting
WITHIN 20 MINUTES OF QUITTING SMOKING...

YOUR BODY BEGINS A SERIES OF CHANGES THAT CONTINUE FOR YEARS.

20 MINUTES
Your heart rate drops.

2 WEEKS - 3 MONTHS
Your heart attack risk begins to drop.
Your lung function begins to improve.

1 YEAR
Your added risk of coronary heart disease is half that of a smoker’s.

10 YEARS
Your lung cancer death rate is about half that of a smoker’s.
Your risk of cancers of the mouth, throat, esophagus, bladder, kidney, and pancreas decreases.

12 HOURS
Carbon monoxide level in your blood drops to normal.

1-9 MONTHS
Your coughing and shortness of breath decrease.

5 YEARS
Your stroke risk is reduced to that of a nonsmoker’s 5-15 years after quitting.

15 YEARS
Your risk of coronary heart disease is back to that of a nonsmoker’s.

FOR MORE INFORMATION VISIT CDC.GOV

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### Stopping smoking improves mental health

Taylor et. al. (BMJ 2014)

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Number of studies</th>
<th>Standardized mean difference (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anxiety</td>
<td>4</td>
<td>-0.37 (-0.70 to -0.03)</td>
</tr>
<tr>
<td>Depression</td>
<td>9</td>
<td>-0.29 (-0.43 to -0.15)</td>
</tr>
<tr>
<td>Mixed anxiety and depression</td>
<td>4</td>
<td>-0.36 (-0.58 to -0.15)</td>
</tr>
<tr>
<td>Positive affect</td>
<td>1</td>
<td>0.68 (0.24 to 1.12)</td>
</tr>
<tr>
<td>Stress</td>
<td>2</td>
<td>-0.23 (-0.39 to -0.07)</td>
</tr>
</tbody>
</table>

- Smoking cessation is associated with improvement in mental health in comparison with continuing to smoke
- The effects are equal to or larger to those of antidepressant treatment
Learning Objectives

• Select strategies that have decreased smoking consumption at a population level
• Recognize causes of tobacco-related death
• Identify the properties of carbon monoxide (MO)
• Select the Diagnostic and Statistical Manual’s (DSM 5) list of tobacco withdrawal symptoms
• Recall which diseases reverse with smoking cessation