Tobacco use remains the single largest preventable cause of disease and premature death in the U.S.

According to the “National Survey on Drug Use and Health,” more than 51.3 million (19.1%) Americans still smoke cigarettes.

As of 2016, there were also:

- 12.3 million (4.6%) cigar smokers
- 10.7 million (4%) e-cigarette users
- 8.8 million (3.3%) smokeless tobacco users (chewing tobacco & snuff)
- 2.3 million (0.8%) who smoke tobacco in pipes
SMOKING CAUSES DAMAGE THROUGHOUT THE BODY

Tobacco smoke contains more than 7,000 chemicals and compounds. Hundreds of these are toxic, and at least 69 are cancer causing. When you use tobacco, you risk developing:

- Blindness (Macular Degeneration)
- Impaired Sense of Smell
- Cancer of Lips and Mouth
- Impaired Sense of Taste
- Halitosis
- Heart Disease
- Gastric Cancer
- Colon Cancer
- Pancreatic Cancer
- Infertility
- Impotence
- Throat Cancer
- Larynx Cancer
- Pharynx Cancer
- Esophageal Cancer
- Tracheal Cancer
- Lung Cancer
- Bronchus Cancer
- Chronic Obstructive Pulmonary Disease
- Asthma
- Cervical Cancer
- Early Menopause
- Reduced Fertility
LIFelong SMokers have a one-in-two chance of dying from smoking-related disease.

It'll never happen to me.

The odds of winning the Powerball lottery are 80 million to one.

This could be my lucky day!
DOLLARS ARE WASTED

VALUABLE RESOURCES ARE SPENT TREATING TOBACCO-RELATED ILLNESSES

Tobacco-Related Health Care Costs (2000-2012)

- US: $133 B
- France: $16.6 B
- UK: $9.5 B
- China: $6.2 B
- Canada: $2.8 B

Missed Opportunities for Programs and Services

- Education
- Public Safety
- Rural Development
- Transportation

Total Missed Opportunities: $133 B
SOCIETY PAYS AND SO DO YOU

THE BURDEN OF DEATH, DISEASE, AND DISABILITY LIES BEYOND THE SMOKER

SOCIETY
Tobacco-related health care costs and productivity loss in the US

$289 BILLION

YOU

$6.36
AVERAGE PRICE PER PACK OF CIGARETTES IN THE US

$35
HEALTH-RELATED COSTS TO YOU PER PACK OF CIGARETTES
Figure 3. Leading Sites of New Cancer Cases and Deaths – 2017 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>161,360</td>
<td>252,710</td>
</tr>
<tr>
<td>Lung &amp; bronchus</td>
<td>Lung &amp; bronchus</td>
</tr>
<tr>
<td>116,990</td>
<td>105,510</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>Colon &amp; rectum</td>
</tr>
<tr>
<td>71,420</td>
<td>64,010</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>Uterine corpus</td>
</tr>
<tr>
<td>60,490</td>
<td>61,380</td>
</tr>
<tr>
<td>Melanoma of the skin</td>
<td>Thyroid</td>
</tr>
<tr>
<td>52,170</td>
<td>42,470</td>
</tr>
<tr>
<td>Kidney &amp; renal pelvis</td>
<td>Melanoma of the skin</td>
</tr>
<tr>
<td>40,610</td>
<td>34,940</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>Non-Hodgkin lymphoma</td>
</tr>
<tr>
<td>40,080</td>
<td>32,160</td>
</tr>
<tr>
<td>Leukemia</td>
<td>Leukemia</td>
</tr>
<tr>
<td>36,290</td>
<td>25,840</td>
</tr>
<tr>
<td>Oral cavity &amp; pharynx</td>
<td>Pancreas</td>
</tr>
<tr>
<td>35,720</td>
<td>25,700</td>
</tr>
<tr>
<td>Liver &amp; intrahepatic bile duct</td>
<td>Kidney &amp; renal pelvis</td>
</tr>
<tr>
<td>29,200</td>
<td>23,380</td>
</tr>
<tr>
<td><strong>All sites</strong></td>
<td><strong>All sites</strong></td>
</tr>
<tr>
<td><strong>836,150</strong></td>
<td><strong>852,630</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>84,590</td>
<td>71,280</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>Breast</td>
</tr>
<tr>
<td>27,150</td>
<td>40,610</td>
</tr>
<tr>
<td>Prostate</td>
<td>Colon &amp; rectum</td>
</tr>
<tr>
<td>26,730</td>
<td>23,110</td>
</tr>
<tr>
<td>Pancreas</td>
<td>Pancreas</td>
</tr>
<tr>
<td>22,300</td>
<td>20,790</td>
</tr>
<tr>
<td>Liver &amp; intrahepatic bile duct</td>
<td>Ovary</td>
</tr>
<tr>
<td>19,610</td>
<td>14,080</td>
</tr>
<tr>
<td>Leukemia</td>
<td>Uterine corpus</td>
</tr>
<tr>
<td>14,300</td>
<td>10,920</td>
</tr>
<tr>
<td>Esophagus</td>
<td>Leukemia</td>
</tr>
<tr>
<td>12,720</td>
<td>10,200</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>Liver &amp; intrahepatic bile duct</td>
</tr>
<tr>
<td>12,240</td>
<td>9,310</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>Non-Hodgkin lymphoma</td>
</tr>
<tr>
<td>11,450</td>
<td>8,690</td>
</tr>
<tr>
<td>Brain &amp; other nervous system</td>
<td>Brain &amp; other nervous system</td>
</tr>
<tr>
<td>9,620</td>
<td>7,080</td>
</tr>
<tr>
<td><strong>All sites</strong></td>
<td><strong>All sites</strong></td>
</tr>
<tr>
<td><strong>318,420</strong></td>
<td><strong>282,500</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.
Figure 3. Leading Sites of New Cancer Cases and Deaths – 2017 Estimates

<table>
<thead>
<tr>
<th>Estimation Type</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated New Cases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prostate</td>
<td>161,360</td>
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<td>Non-Hodgkin lymphoma 32,160</td>
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</tr>
<tr>
<td>All sites</td>
<td>836,150</td>
<td>All sites 852,630</td>
</tr>
</tbody>
</table>

| Estimated Deaths         |                               |                               |
|--------------------------|                               |                               |
| Prostate                 | 51,400                        |                                 |
| Colon & rectum           | 27,150                        |                                 |
| Lung & bronchus          | 27,150                        |                                 |
| Pancreas                 | 22,300                        |                                 |
| Liver & intrahepatic bile duct | 19,610          |                                 |
| Leukemia                 | 14,300                        |                                 |
| Esophagus                | 12,720                        |                                 |
| Urinary bladder          | 12,240                        |                                 |
| Non-Hodgkin lymphoma     | 11,450                        |                                 |
| Brain & other nervous system | 9,620          |                                 |
| All sites                | 318,420                       | All sites 282,500              |

Estimates are rounded to the nearest 10, and cases exclude basal cell and squamous cell skin cancers and in situ carcinoma except urinary bladder.
The Facts About Lung Cancer

• Not counting skin cancer, lung cancer is the 2nd most common cancer in both men and women:
  – In men, prostate cancer is more common.
  – In women, breast cancer is more common.
• Lung cancer accounts for 13% of all new cancers.
• Lung cancer is the leading cause of cancer death in the United States.
• Lung cancer causes 26% of all cancer deaths.
• Lung cancer is the leading cancer killer among Caucasians, African-Americans, Asians and Hispanic males.
State Cigarette Excise Tax, 2017*

*Taxes in effect or increases passed, reported as of April 1, 2017.
Incidence Rates for Maryland
Lung & Bronchus, 2010 - 2014
All Races (includes Hispanic), Both Sexes, All Ages

Notes:
State Cancer Registries may provide more current or more local data.

Data presented on the State Cancer Profiles Web Site may differ from statistics reported by the State Cancer Registries (for more information).

Incidence rates (cases per 100,000 population per year) are age-adjusted to the 2000 US standard population (19 age groups: <1, 1-4, 5-9, ..., 80-84, 85+). Rates are for invasive cancer only (except for bladder which is invasive and in situ) or unless otherwise specified. Rates calculated using SEER*Stat. Population counts for denominators are based on Census populations as modified by NCI. The 1989-2015 US Population Data File is used for SEER and NPCR incidence rates.

Data for the United States does not include data from Puerto Rico.
Figure 1. Trends in Age-adjusted Cancer Death Rates* by Site, Males, US, 1930-2014

*Per 100,000, age adjusted to the 2000 US standard population. †Mortality rates for pancreatic and liver cancers are increasing.

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


©2017, American Cancer Society, Inc., Surveillance Research
Figure 2. Trends in Age-adjusted Cancer Death Rates* by Site, Females, US, 1930-2014

*Per 100,000, age adjusted to the 2000 US standard population. 1Uterus refers to uterine cervix and uterine corpus combined. †The mortality rate for liver cancer is increasing.

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

Dr. Batty's

For Your Health

Asthma Cigarettes

Since 1882

For the temporary relief of
paroxysms of asthma

Effectively treats:
Asthma, Hay Fever, Foul Breath
All Diseases of the Throat,
Head Colds, Canker Sores
Bronchial Irritations

Not Recommended for Children under 6.
Why Physicians Call Our New Brand

“A HEALTH CIGAR”

“I recommend Thompson’s MELL-O-WELL cigars to any who are interested in regaining or keeping physical fitness.”

“I am convinced that irritants, such as nicotines, glycerides, albuminoids and carbons—dangerous when used to excess by those who are physically below par—are largely removed from Thompson’s MELL-O-WELL cigars.”

“Many former patients, friends and others who have consulted me, and who, ordinarily, would be obliged to greatly curtail smoking, are now enjoying their usual allotment of cigars in Thompson’s MELL-O-WELLS—with no loss of satisfaction or good health.”

(Signed) G. Edward Roehrig, M. D.
715 South Bonnie Brae,
Los Angeles, Calif.
20,679* Physicians say "LUCKIES are less irritating"

"It's toasted"
Your Throat Protection against irritation against cough

* The figures quoted have been checked and certified to by LYBRAND, ROSS BROS. AND MONTGOMERY, Accountants and Auditors.
According to repeated nationwide surveys,

More Doctors Smoke CAMELS
than any other cigarette!
Excellent health statistics - smokers are less likely to die of age related illnesses.
“Are you sure you don’t want to add something about smoking?”
Verdict on Cigaretts: Guilty as Charged

The 13-man jury had been out for more than a year weighing the case against cigarettes. Now Surgeon General Luther L. Terry, holding in his hand the jury's 385-page report, announced to the nation its unanimous verdict on the cigraret guity as charged of being a menace to health. Cigarettes, said the report, are a major cause of lung cancer and chronic bronchitis. And they help shorten a smoker's life in a number of other ways. This had been said before. But now it was being said with greater authority by the Surgeon General's Advisory Committee, a group of distinguished medical men whose appointmenets were approved by the tobacco industry.

Many Americans had hoped the verdict would be different: tobacco people, farmers, politicians, newspaper, publishers, advertisers, men—and not least of all, the American smoker, who has mightily invested the idea that he is a confident friend. The cigaret had all along been a villain.
Trends in Cigarette Smoking by Gender, Adults 18 and Older, US, 1965-2015

Prevalence (%)

- Men
  - 1965: 51%
  - 2015: 17%
- Women
  - 1965: 34%
  - 2015: 14%
Figure 1B. Current Cigarette Smoking* Trends, Adults 18 Years and Older by Race/Ethnicity, US, 1990-2015

*Ever smoked 100 cigarettes in lifetime and smoking every day or some days at time of survey. Note: Estimates are age adjusted to the 2000 US standard population.

©2017, American Cancer Society, Inc., Surveillance Research
Lung and Bronchus Cancer

New Cases, Deaths and 5-Year Relative Survival

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5-Year Relative Survival</td>
<td>11.4%</td>
<td>12.5%</td>
<td>13.1%</td>
<td>13.3%</td>
<td>14.5%</td>
<td>15.7%</td>
<td>17.4%</td>
<td>19.6%</td>
</tr>
</tbody>
</table>

Based upon 2010-2014 statistics, there were 55.8 new lung cancer cases per year per 100,000 men and women in the U.S.
Based upon 2010-2014 statistics, there were 44.7 lung cancer deaths per year per 100,000 men and women in the U.S.

The percent of lung and bronchus cancer deaths is highest among people aged 65–74.

Median Age At Death

72
### Lung and Bronchus Cancer Statistics

<table>
<thead>
<tr>
<th>Estimated New Cases in 2017</th>
<th>222,500</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of All New Cancer Cases</td>
<td>13.2%</td>
</tr>
<tr>
<td>Estimated Deaths in 2017</td>
<td>155,870</td>
</tr>
<tr>
<td>% of All Cancer Deaths</td>
<td>25.9%</td>
</tr>
</tbody>
</table>

#### Number of New Cases and Deaths per 100,000:
The number of new cases of lung and bronchus cancer was 55.8 per 100,000 men and women per year. The number of deaths was 44.7 per 100,000 men and women per year. These rates are age-adjusted and based on 2010–2014 cases and deaths.

#### Lifetime Risk of Developing Cancer:
Approximately 6.4 percent of men and women will be diagnosed with lung and bronchus cancer at some point during their lifetime, based on 2012–2014 data.

#### Prevalence of This Cancer:
In 2014, there were an estimated 527,228 people living with lung and bronchus cancer in the United States.
Lung and Bronchus Cancer Statistics

Number of New Cases and Deaths per 100,000: The number of new cases of lung and bronchus cancer was 55.8 per 100,000 men and women per year. The number of deaths was 44.7 per 100,000 men and women per year. These rates are age-adjusted and based on 2010–2014 cases and deaths.

Lifetime Risk of Developing Cancer: Approximately 6.4 percent of men and women will be diagnosed with lung and bronchus cancer at some point during their lifetime, based on 2012–2014 data.

Prevalence of This Cancer: In 2014, there were an estimated 527,228 people living with lung and bronchus cancer in the United States.
# How Common is Lung and Bronchus Cancer?

<table>
<thead>
<tr>
<th>Common Types of Cancer</th>
<th>Estimated New Cases 2017</th>
<th>Estimated Deaths 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Breast Cancer (Female)</td>
<td>252,710</td>
<td>40,610</td>
</tr>
<tr>
<td>2. Lung and Bronchus Cancer</td>
<td>222,500</td>
<td>155,870</td>
</tr>
<tr>
<td>3. Prostate Cancer</td>
<td>161,360</td>
<td>26,730</td>
</tr>
<tr>
<td>4. Colon and Rectum Cancer</td>
<td>135,430</td>
<td>50,260</td>
</tr>
<tr>
<td>5. Melanoma of the Skin</td>
<td>87,110</td>
<td>9,730</td>
</tr>
<tr>
<td>6. Bladder Cancer</td>
<td>79,030</td>
<td>16,870</td>
</tr>
<tr>
<td>7. Non-Hodgkin Lymphoma</td>
<td>72,240</td>
<td>20,140</td>
</tr>
<tr>
<td>8. Kidney and Renal Pelvis Cancer</td>
<td>63,990</td>
<td>14,400</td>
</tr>
<tr>
<td>9. Leukemia</td>
<td>62,130</td>
<td>24,500</td>
</tr>
<tr>
<td>10. Endometrial Cancer</td>
<td>61,380</td>
<td>10,920</td>
</tr>
</tbody>
</table>

Lung and bronchus cancer represents 13.2% of all new cancer cases in the U.S.

In 2017, it is estimated that there will be 222,500 new cases of lung and bronchus cancer and an estimated 155,870 people will die of this disease.
How Many People Survive 5 Years or More After Being Diagnosed With Lung and Bronchus Cancer?

Based on data from SEER 18 2007–2013. Gray figures represent those who have died from lung and bronchus cancer. Green figures represent those who have survived 5 years or more.
Percent of Cases & 5-Year Relative Survival by Stage at Diagnosis: Lung and Bronchus Cancer

**Percent of Cases by Stage**
- Localized (16%) Confined to Primary Site
- Regional (22%) Spread to Regional Lymph Nodes
- Distant (57%) Cancer Has Metastasized
- Unknown (5%) Unstaged

**5-Year Relative Survival**
- Localized: 55.6%
- Regional: 28.9%
- Distant: 4.5%
- Unstaged: 7.5%

SEER 18 2007–2013, All Races, Both Sexes by SEER Summary Stage 2000
Cumulative Survival by Pathologic Stage

![Graph showing cumulative survival by pathologic stage with data points for different stages: IA (1168/3666, MST 5-Year 119 73%), IB (1450/3100, MST 5-Year 81 58%), IIA (1485/2579, MST 5-Year 49 46%), IIB (1502/2252, MST 5-Year 31 36%), IIIA (2896/3792, MST 5-Year 22 24%), IIIB (263/297, MST 5-Year 13 9%), IV (224/266, MST 5-Year 17 13%).](image)
The Facts About Lung Cancer

- Over 50% of new lung cancer cases will be diagnosed at a very late stage:
  - stage III-B or
  - stage IV
- Less than 5% of those cases will live for 5 years.
The Facts About Lung Cancer

Lung cancer will kill more people this year than:

- breast cancer
- prostate cancer
- colon cancer
- skin melanoma
- bladder cancer
- endometrial cancer

... COMBINED!
Lung cancer will kill more than 3x as many men as prostate cancer this year.

Lung cancer will kill nearly twice as many women as breast cancer this year.
We make Virginia Slims especially for women because they are biologically superior to men.

That’s right, superior. Women are more resistant to starvation, fatigue, exposure, shock, and illness than men are. Women have two “X” chromosomes in their sex cells, while men have only one “X” chromosome and a “Y” chromosome... which some experts consider to be the inferior chromosome. They are also less inclined than men to congenital baldness, Albinism of the eyes, improperly developed sweat glands, color blindness of the red-green type, dry blindness, defective hair follicles, defective iris, defective tooth enamel, double eyelashes, skin cysts, shortsightedness, night blindness, naevus, retinal detachment, and white occipital lack of hair.

In view of these and other facts, the makers of Virginia Slims feel it is highly inappropriate that women continue to use the fat, stubby cigarettes designed for men.

Virginia Slims.
Slimmer than the big cigarettes men smoke. With a Virginia flavor women like.

You’ve come a long way, baby.
LUNG CANCER IS THE LEADING CAUSE OF CANCER DEATH (i)

SNAPSHOT OF PEOPLE WITH LUNG CANCER (ii)

The Facts About Lung Cancer

**Myth:**
After you stop smoking, your lungs go “back to normal” in 10 years.

**Truth:**
The lungs never go completely “back to normal.” Most former smokers remain at elevated risk.

- Current smokers: 20.9% of new lung cancer cases.
- Former smokers: 61.2% of new lung cancer cases.
- Never smoked: 17.9% of new lung cancer cases.
NCI Lung Cancer Research Portfolio

- Scientific Model Systems: 4%
- Biology: 15%
- Etiology (Causes of Cancer): 11%
- Prevention: 11%
- Early Detection, Diagnosis, & Prognosis: 12%
- Treatment: 26%
- Cancer Control, Survivorship, & Outcomes Research: 21%

Percentage of Total Dollars by Scientific Area Fiscal Year 2013
Lung Cancer Research Funding and Mortality

FY 2010 Federal Research Dollars Per Death

Breast: $24,547
Prostate: $12,286
Colorectal: $6,024
Lung: $1,887

Five Year Survival Rates...
Little Progress for Lung Cancer

Breast: 90%
Prostate: 100%
Colorectal: 66%
Lung: 12%

(Federal spending from the combines FY2010 research dollars of the National Cancer Institute, Department of Defense and Centers for Disease Control and Prevention. Estimated cancer deaths from the American Cancer Society: Cancer Facts and Figures 2010. 5-year survival rates [based on year of diagnosis] from the SEER Cancer Statistics Review 1975-2008.)
LUNG CANCER MORTALITY REDUCTION MUST BECOME A PUBLIC HEALTH PRIORITY. WHY?

BECAUSE MORE PEOPLE WILL DIE OF LUNG CANCER THAN BREAST, PROSTATE AND COLON CANCER COMBINED.
Screening by Chest Radiograph and Lung Cancer Mortality

The Prostate, Lung, Colorectal, and Ovarian (PLCO) Randomized Trial

Maria M. Osteen, MD
William G. Hoekstra, MD
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Gerald T. Andrelo, MD
Sandra S. Burs, MD
Timothy K. Church, PhD, MD
E. David Crawford, MD
Wyns M. Fosan, MD
odiene Jason, MD
Theodore J. Boling, MD, MPH
Joel L. Wandelred, MD, MPH
Larry A. Yoshida, MD, PhD
Barbara O'Kelly, MPH
Lawrence K. Regan, MD
Domingo M. Reemel, MD
Thomas L. Black, BS
Patrick Wright, BS
Neil Garapino, MD
Peg Ho, PhD
Grain Minchull, PhD
Paul F. Pinsky, PhD
Philip C. Puskely, PhD
Barrett S. Kramer, MD, MPH
Anthony B. Miller, MD
John K. Gehagan, PhD
Christina D. Boyer, MD
for the PLCO Dietopt Team

Lung cancer is the leading cause of cancer death in the United States and worldwide. Screening for lung cancer has long been studied as an approach to reducing the burden of lung cancer. Randomized trials conducted in the 1970s and 1980s using screening spiro

tomography and chest radiography failed to detect a significant reduction in lung cancer mortality in the group offered more extensive screening. Results of the National Lung Screening Trial (NLST), comparing screening with low-dose spiral computed tomography (CT) with chest radiography, demonstrated a 20% reduction in lung cancer mortality in the CT group. **

Contact: The effect on mortality of screening for lung cancer with modern chest radiographs is unknown.

Objective: To evaluate the effect on mortality of screening for lung cancer using chest radiographs in the Prostate, Lung, Colorectal, and Ovarian (PLCO) Cancer Screening Trial.

Design, Setting, and Participants: Randomized controlled trial that involved 15,491 participants aged 55 through 74 years, 77% of whom were assigned to annual screening or chestradiography.

Intervention: Participants in the intervention group were offered annual posteroanterior chest radiography for 4 years. Follow-up of positive screening results was determined by participants and their health care practitioners. Participants in the usual care group were offered no interventions and received their usual medical care. All diagnoses, deaths, and causes of death were ascertained through the earlier of 13 years of follow-up or before December 31, 2009.

Main Outcome Measure: Mortality from lung cancer. Secondary outcomes included lung cancer incidence, complications associated with diagnostic procedures, and all-cause mortality.

Results: Screening adherence was 86.6% at baseline and 75% to 84% at years 1 through 3. The rate of screening use in the usual care group was 71%. Cumulative lung cancer incidence rates through 13 years of follow-up were 20.1 per 10,000 person-years in the intervention group and 19.2 per 10,000 person-years in the usual care group (RR: 1.00, 95% CI: 0.96-1.03). A total of 1,231 lung cancer deaths were ascertained in the intervention group compared with 1,320 in the usual care group through 13 years (mortality RR: 0.99, 95% CI: 0.87-1.12). Stage and severity were similar between the 2 groups. The RR of mortality for the subset of participants eligible for the NLST, over the same 6-year follow-up period, was 3.94 (95% CI: 0.81-1.10).

Conclusion: Annual screening with chest radiography did not reduce lung cancer mortality compared with usual care.

Trial Registration: clinicaltrials.gov Identifier: NCT00002340


Published online October 26, 2011. doi:10.1001/jama.2011.1977

www.jama.com

For editorial comment see p1916.
Screening by Chest Radiograph and Lung Cancer Mortality
The Prostate, Lung, Colorectal, and Ovarian (PLCO) Randomized Trial

Figure 2. Lung Cancer Incidence by Year

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Screening by Chest Radiograph and Lung Cancer Mortality
The Prostate, Lung, Colorectal, and Ovarian (PLCO) Randomized Trial

Figure 3. Lung Cancer Mortality by Year

<table>
<thead>
<tr>
<th>Time Since Randomization, y</th>
<th>Intervention group</th>
<th>Usual care group</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>16</td>
<td>18</td>
</tr>
<tr>
<td>1</td>
<td>23</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>36</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>46</td>
<td>51</td>
</tr>
<tr>
<td>4</td>
<td>53</td>
<td>60</td>
</tr>
<tr>
<td>5</td>
<td>60</td>
<td>66</td>
</tr>
<tr>
<td>6</td>
<td>68</td>
<td>73</td>
</tr>
<tr>
<td>7</td>
<td>73</td>
<td>78</td>
</tr>
<tr>
<td>8</td>
<td>78</td>
<td>83</td>
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<tr>
<td>9</td>
<td>84</td>
<td>88</td>
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<tr>
<td>10</td>
<td>91</td>
<td>95</td>
</tr>
<tr>
<td>11</td>
<td>94</td>
<td>98</td>
</tr>
<tr>
<td>12</td>
<td>100</td>
<td>104</td>
</tr>
<tr>
<td>13</td>
<td>106</td>
<td>110</td>
</tr>
</tbody>
</table>

Cumulative Deaths
Intervention group: 36, 113, 196, 292, 378, 480, 582, 711, 838, 937, 1070, 1150, 1213

Usual care group: 30, 111, 198, 301, 426, 527, 639, 761, 884, 987, 1076, 1162, 1230
Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening

The National Lung Screening Trial Research Team

ABSTRACT

BACKGROUND
The aggressive and heterogeneous nature of lung cancer has thwarted efforts to reduce mortality from this cancer through the use of screening. The advent of low-dose helical computed tomography (CT) altered the landscape of lung-cancer screening, with studies indicating that low-dose CT detects many tumors at early stages. The National Lung Screening Trial (NLST) was conducted to determine whether screening with low-dose CT could reduce mortality from lung cancer.

METHODS
From August 2002 through April 2004, we enrolled 53,454 persons at high risk for lung cancer at 33 U.S. medical centers. Participants were randomly assigned to undergo three annual screenings with either low-dose CT (26,732 participants) or single-view posteroanterior chest radiography (26,722). Data were collected on cases of lung cancer and deaths from lung cancer that occurred through December 31, 2008.

RESULTS
The rate of adherence to screening was more than 90%. The rate of positive screening tests was 24.2% with low-dose CT and 5.6% with radiography over all three rounds. A total of 94.4% of the positive screening results in the low-dose CT group and 94.5% in the radiography group were false positive results. The incidence of lung cancer was 64 cases per 100,000 person-years (1606 cancers) in the low-dose CT group, as compared with 572 cases per 100,000 person-years (941 cancers) in the radiography group (rate ratio, 1.15; 95% confidence interval [CI], 1.00 to 1.31). There were 264 deaths from lung cancer per 100,000 person-years in the low-dose CT group and 309 deaths per 100,000 person-years in the radiography group, representing a relative reduction in mortality from lung cancer with low-dose CT screening of 20.3% (95% CI, 6.8 to 30.7; P=0.004). The rate of death from any cause was reduced in the low-dose CT group, as compared with the radiography group, by 6.7% (95% CI, 1.2 to 13.6; P=0.02).

CONCLUSIONS
Screening with the use of low-dose CT reduces mortality from lung cancer. (Funded by the National Cancer Institute, National Lung Screening Trial ClinicalTrials.gov number, NCT00547385.)
Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening

The National Lung Screening Trial Research Team*

Eligibility
• Age 55-74
• Smoking history ≥30 pack-years
• Smoking within the previous 15 years

Exclusion Criteria
• Previous diagnosis of lung cancer
• CT within 18 months before enrollment
• Hemoptysis
• Unexplained weight loss >15 lbs. in preceding year
Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening

The National Lung Screening Trial Research Team

Schema
Random assignment to 3 annual screenings with either
• Chest X-ray
  or
• Low-dose CT scan

Study Period
• Enrollment from August 2002 until April 2004
• Screening from August 2002 until September 2007
• Followup until December 31, 2009
Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening

The National Lung Screening Trial Research Team*

Enrollment
• 53,454 participants
• 33 U.S. medical centers

Findings
• High rate of false positive studies (>90%).
• Low-dose CT arm:
  – 20% reduction in mortality from lung cancer.
  – 6.7% reduction in mortality from all causes.
Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening

The National Lung Screening Trial Research Team*

A  Lung Cancer

Cumulative No. of Lung Cancers

Low-dose CT

Chest radiography

Years since Randomization

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Reduced Lung-Cancer Mortality with Low-Dose Computed Tomographic Screening

The National Lung Screening Trial Research Team

B Death from Lung Cancer

Cumulative No. of Lung-Cancer Deaths

Years since Randomization

- Chest radiography
- Low-dose CT

\[ P = 0.004 \]
## Study Findings: Low-dose CT versus Chest X-ray screening

53,454 current and former smokers were randomly assigned to be screened once a year for 3 years with low-dose CT or chest X-ray. Here’s what happened after an average of 6.5 years:

<table>
<thead>
<tr>
<th>Benefit: How did CT scans help compared to chest X-ray, an ineffective screening test?</th>
<th>Low-dose CT 26,722 people</th>
<th>Chest X-ray 26,732 people</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 in 1,000 fewer died from lung cancer</td>
<td>18 in 1,000</td>
<td>versus 21 in 1,000</td>
</tr>
<tr>
<td>5 in 1,000 fewer died from all causes</td>
<td>70 in 1,000</td>
<td>versus 75 in 1,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Harm: What problems did CT scans cause compared to chest X-ray?</th>
<th>Low-dose CT 26,722 people</th>
<th>Chest X-ray 26,732 people</th>
</tr>
</thead>
<tbody>
<tr>
<td>223 in 1,000 more had at least one false alarm</td>
<td>365 in 1,000</td>
<td>versus 142 in 1,000</td>
</tr>
<tr>
<td>18 in 1,000 more had a <strong>false alarm leading to an invasive procedure</strong>, such as bronchoscopy, biopsy, or surgery</td>
<td>25 in 1,000</td>
<td>versus 7 in 1,000</td>
</tr>
<tr>
<td>2 in 1,000 more had a major complication from Invasive procedures</td>
<td>3 in 1,000</td>
<td>versus 1 in 1,000</td>
</tr>
</tbody>
</table>
Screening for Lung Cancer

The U.S. Preventive Services Task Force (Task Force) has issued a final recommendation statement on Screening for Lung Cancer.

This final recommendation statement applies to adults who have no signs or symptoms of lung cancer but who are at high risk for developing the disease because of their age and smoking history.

The final recommendation statement summarizes what the Task Force learned about the potential benefits and harms of screening for lung cancer:

Adults between 55 and 80 years old who are at high risk for lung cancer because they are current heavy smokers or have quit within the past 15 years should be screened every year with a test called low-dose computed tomography.

This fact sheet explains these recommendations and what they might mean for you.

What is lung cancer?

Lung cancer is cancer that occurs in several kinds of cells in the lung. As with other cancers, lung cancer happens when abnormal cells grow out of control. These cells can form a tumor or spread to other parts of the body.
<table>
<thead>
<tr>
<th>Grade</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Recommended.</td>
</tr>
<tr>
<td>B</td>
<td>Recommended.</td>
</tr>
<tr>
<td>C</td>
<td>Recommendation depends on the patient’s situation.</td>
</tr>
<tr>
<td>D</td>
<td>Not recommended.</td>
</tr>
<tr>
<td>I statement</td>
<td>There is not enough evidence to make a recommendation.</td>
</tr>
</tbody>
</table>
The Task Force recommends annual screening for lung cancer with low-dose computed tomography in adults aged 55 to 80 years who have a 30 pack-year smoking history and currently smoke or have quit within the past 15 years. Screening should be discontinued once the individual has not smoked for 15 years or develops a health problem that significantly limits life expectancy or the ability or willingness to have curative lung surgery. Grade B
# Lung Cancer Screening Guidelines and Recommendations

<table>
<thead>
<tr>
<th>Organization</th>
<th>Groups eligible for screening</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>American Academy of Family Practice*</td>
<td>Evidence is insufficient to recommend for or against screening.</td>
<td>2013</td>
</tr>
</tbody>
</table>
| American Association for Thoracic Surgery*        | 1. Age 55 to 79 years with ≥ 30 pack-year smoking history  
2. Long-term lung cancer survivors who have completed 4 years of surveillance without recurrence, and who can tolerate lung cancer treatment in order to detect second primary lung cancer until the age of 79.  
3. Age 50 to 79 years with a 20 pack-year smoking history and additional comorbidity that produces a cumulative risk of developing lung cancer ≥ 5% in 5 years. | 2012 |
| American Cancer Society*                          | Age 55 to 74 years with ≥ 30 pack-year smoking history, either currently smoking or have quit within the past 15 years, and who are in relatively good health.                                                                                             | 2013 |
| American College of Chest Physicians*             | Age 55 to 74 years with ≥ 30 pack-year smoking history and either continue to smoke or have quit within the past 15 years.                                                                                                         | 2013 |
| American College of Chest Physicians and American Society of Clinical Oncology* | Age 55 to 74 years with ≥ 30 pack-year smoking history and either continue to smoke or have quit within the past 15 years.                                                                                                         | 2012 |
| American Lung Association*                        | Age 55 to 74 years with ≥ 30 pack-year smoking history and no history of lung cancer.                                                                                                                                      | 2012 |
| National Comprehensive Cancer Network†            | 1. Age 55 to 74 years with ≥ 30 pack-year smoking history and smoking cessation < 15 years.                                                                                                                                    | 2012 |
|                                                   | 2. Age ≥ 50 years and ≥ 20 pack-year smoking history and 1 additional risk factor (other than secondhand smoke).                                                                                                                                               |      |
| U.S. Preventive Services Task Force†              | Age 55 to 80 years with ≥ 30 pack-year smoking history and smoking cessation < 15 years.                                                                                                                                          | 2013 |

*Additional risk factors include cancer history, lung disease history, family history of lung cancer, radon exposure, occupational exposure, and history of chronic obstructive pulmonary disease or pulmonary fibrosis. Cancers with increased risk of developing new primary lung cancer include survivors of lung cancer, lymphomas, cancer of the head and neck, and smoking-related cancers. Occupational exposures identified as carcinogens targeting the lungs include silica, cadmium, asbestos, arsenic, beryllium, chromium (VI), diesel fumes, and nickel.
Your Decision About Screening

- Your health and lifestyle
- Your personal values
- Scientific recommendations
- Advice from your health care professional
Comparing Sources of Radiation

<table>
<thead>
<tr>
<th>Source</th>
<th>millisieverts (mSv)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air travel 10 hours</td>
<td>0.04 mSv</td>
<td>-</td>
</tr>
<tr>
<td>Chest X-ray</td>
<td>0.1 mSv</td>
<td>-</td>
</tr>
<tr>
<td>Mammogram</td>
<td>0.4 mSv</td>
<td>-</td>
</tr>
<tr>
<td>LDCT for lung cancer screening</td>
<td>1.4 mSv</td>
<td>-</td>
</tr>
<tr>
<td>Average background radiation (U.S., 1 year)</td>
<td>3 to 5 mSv</td>
<td>-</td>
</tr>
<tr>
<td>Diagnostic CT</td>
<td>7 mSv</td>
<td>-</td>
</tr>
</tbody>
</table>

mSv = millisievert, a measure of the amount of radiation absorbed by the body.
BENEFIT: Greater chance of not dying from lung cancer

- If 1,000 people are not screened with LDCT for lung cancer, 21 will die from lung cancer.
- If 1,000 people are screened with LDCT once a year for 3 years, 18 will die from lung cancer.
- This means that with LDCT screening, 3 fewer people will die from lung cancer.
BENEFIT: Greater chance of not dying from any cause (not just lung cancer)

» If 1,000 people are not screened with LDCT for lung cancer, 75 will die from any cause.

» If 1,000 people are screened with LDCT once a year for 3 years, 70 will die from any cause.

» This means that with LDCT screening, 5 fewer people will die from all causes.
HARM: False alarms and unneeded additional testing

A false alarm happens when a person has a positive screening test but does not actually have lung cancer.

» If 1,000 people are screened every year for 3 years, about 356 will have a false alarm.

» Of these 356 people with a false alarm, 18 will have an invasive procedure such as a biopsy (a tiny piece of lung tissue is removed to test for cancer).

» Of these 18 people, less than 1 will have a major complication as a result of the procedure, such as bleeding in the lung, a collapsed lung, or an infection.
Biopsy performed under fluoroscopic control

Syringe

Aspiration gun

Large bore needle

Biopsy needle
Out of 1,000 people screened with LDCT for lung cancer:

- 356 people will get a "false alarm."  
  19 of the people who get a "false alarm" will have an invasive procedure like a biopsy.  
  Less than 1 of the 19 people who have an invasive procedure will have a major complication (e.g., infection, bleeding in lung, collapsed lung).

- 18 people will die of lung cancer.

Out of 1,000 people not screened with LDCT for lung cancer:

- 21 people will die of lung cancer.

* For people screened once a year for 3 years and followed for an average of 6.5 years. This information applies to people who are at high risk of lung cancer because of their smoking history and age.
SCREENED (1,000 PEOPLE)

BENEFITS ADDED by Screening

There were 3 fewer deaths from lung cancer in people SCREENED compared to the NOT SCREENED group. However, 18 PEOPLE still died from lung cancer in a group of 1,000 people who were SCREENED.

HARMs ADDED by Screening

365 IN 1,000 PEOPLE SCREENED experienced a FALSE POSITIVE result such as a spot on the lung that required further testing.

25 of those false positive results led to an INVASIVE PROCEDURE like a biopsy or surgery.

3 PEOPLE developed a MAJOR COMPLICATION from the invasive procedure.

NOT SCREENED (1,000 PEOPLE)

21 PEOPLE DIED from lung cancer in a group of 1,000 people who were NOT SCREENED. This was 3 ADDITIONAL DEATHS from lung cancer compared to the group that was SCREENED.
Who should be screened for lung cancer?

The United States Preventive Services Task Force (USPSTF) is made up of experts in preventive medicine. Without pay, they review the current research to make recommendations about clinical preventive services such as screening, counseling, and preventive medications.

The USPSTF recommends lung cancer screening for individuals who:

» Are 55 to 80 years old
» Do not have any signs or symptoms of lung cancer (diagnostic testing may be recommended for people who do have signs or symptoms of lung cancer)
» Have not had lung cancer before
» Currently smoke or quit less than 15 years ago
» Are or were heavy smokers (30 pack-years history such as those who smoked 1 pack per day for 30 years or 2 packs per day for 15 years)

Remember, the best way to lower your chances of dying from lung cancer is to stop smoking.

More than 8 out of every 10 lung cancer cases in the United States are from smoking.

Lung cancer screening should not be done instead of quitting smoking. If you currently smoke, talk to your health care professional or call the nationwide quit line at:

1-800-QUIT-NOW
(1-800-784-8669)
What about insurance coverage for lung cancer screening?

Private insurance plans cover lung cancer screening for people age 55 through 80, with no out-of-pocket costs.

Medicare pays for lung cancer screening with no out-of-pocket costs for people up to age 77 if you meet the following criteria:

» You must have a written order from your health care professional (your doctor, nurse practitioner, or physician assistant).

» Your visit with your health care professional must be a “shared decisionmaking visit.” In this visit your health care professional must use one or more decision aids and must discuss benefits and harms. Your health care professional must also talk about followup diagnostic testing, overdiagnosis, false alarms, and total radiation exposure from screening.

» You must go to a screening facility that participates in the lung cancer screening registry set up for Medicare patients.

Ask your health care professional about the criteria if you have Medicare coverage.

There may be additional costs for followup tests and/or treatments after the initial screening exam. Contact your insurance company to see if the procedures are covered and what the cost to you would be.
Talking with your health care professional about lung cancer screening

Making the decision to be screened for lung cancer is a personal decision. You should talk with your health care professional and make the decision based on what is right for you.

Below are some questions to think about at your visit with your health care professional. Keep in mind the possible benefits and harms that are most important to you.

» Am I eligible for lung cancer screening?
» What happens if I decide not to be screened for lung cancer?
» Does my insurance cover lung cancer screening?
» Where should I go for lung cancer screening?
» Do I have to do anything to prepare for screening?
» How soon will I know the results of screening?
» What happens if the lung cancer screening shows something of concern?
What is important to you when deciding about screening for lung cancer?

There are many things to think about when deciding whether lung cancer screening is right for you. Below is a list of questions that may help you decide.

<table>
<thead>
<tr>
<th>How important is:</th>
<th>Favors Screening</th>
<th>Favors No Screening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finding lung cancer early when it may be more easily treated?</td>
<td>Very Important</td>
<td>Not Important</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>How concerned are you about:</th>
<th>Favors Screening</th>
<th>Favors No Screening</th>
</tr>
</thead>
<tbody>
<tr>
<td>Having a false alarm?</td>
<td>Not Concerned</td>
<td>Very Concerned</td>
</tr>
<tr>
<td>Having other tests if you have a positive screening test?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Being exposed to radiation from lung cancer screening?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Being treated for lung cancer that never would have harmed you?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Being harmed by the treatments you receive for lung cancer?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
“Take home” messages

Lung cancer screening with CT scans is the only screening test shown to lower the chance of dying from lung cancer. The effect of screening may vary depending on how similar you are to the people who participated in the study. The benefit of screening may be bigger if your lung cancer risk is higher. The harm may be bigger if you have more medical problems (like heart or severe lung disease), which could increase problems from biopsies and surgery.

For perspective, the reduction in deaths from lung cancer with CT screening is larger than the reduction in deaths from the target cancers of other common screening tests, such as mammograms for breast cancer.

There is a tradeoff: CT screening decreases your chance of death but increases your chance of having a false alarm.

If you choose to have CT screening, it is important to have it done at a medical center with special expertise in lung cancer screening and treatment.

Most important thing you can do

DON’T SMOKE. Regardless of your screening decision, avoiding cigarettes is the most powerful way to lower your chance of dying overall or suffering or dying from a variety of diseases, such as lung cancer, emphysema, heart or vascular disease. For example, at age sixty-five, 89 in 1,000 male current smokers will die of lung cancer in the next 10 years versus 4 in 1,000 never smokers. For women, the corresponding figures are 55 in 1,000 versus 5 in 1,000.

For help quitting, call 1-800-QUIT-NOW.
VATS the Difference?

VATS

Open thoracotomy
American Cancer Society Guidelines: Lung Cancer Screening

- Age 55 - 74.
- Asymptomatic.
- Smoking history of at least 30 pack-years.
- History of active smoking within last 15 years.
DON'T SMOKE AND ENCOURAGE OTHERS NOT TO SMOKE

Cigarette smoking is the #1 preventable cause of death in the US.

1/2 of all those who continue to smoke will die from a smoking-related illness.

Quitting tobacco is not easy, but it can be done.
Call us at 1-800-227-2345 or visit cancer.org/smokeout to find tips, tools, and resources to help you or someone you love quit for good.
“That’s what I like best about smoking—it gets me out in the fresh air a couple times a day.”
“I don’t have time to jog or lift weights. If it weren’t for smoking, my lungs wouldn’t get any exercise at all!”
“They say cigarettes can destroy your sense of smell, so as a hospital nurse I think it’s a wise choice.”