ONCOLOGY FOR SCIENTISTS

Cancer Epidemiology & Cancer Survivorship

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Epidemiology is the study of the distribution and determinants of disease frequency in human populations.

Two fundamental assumptions:

- Human disease does not occur at random
- Human disease has causal and preventive factors that can be identified through systematic investigation
EPIDEMIOLOGY

Disease frequency
- how many people are getting disease

Distribution of disease
- who is getting disease
- when and where does disease occur

Determinants of disease
- what causes disease
Focuses on describing people who develop disease in terms of their personal characteristics and where and when they were exposed to the agent causing the disease.

- Provides a systematic method for characterizing a health problem providing basic data on health, disease, and mortality.

- Ensures understanding of the basic dimensions of a health problem.

- Helps identify populations at higher risk for the health problem in relation to person, place, and time.

- Provides information used for allocation of resources

- Enables development of testable hypotheses
**TYPES OF OBSERVATIONAL STUDIES**

**Descriptive** Epidemiology deals with the questions: Who, What, When, and Where

No preconceived ideas about relation between exposure and disease, but results can suggest hypothesis that can be tested by analytical studies.

**Analytic** Epidemiology deals with the remaining questions: Why and How

- Case-Control Studies (Retrospective Studies)
- Cohort Studies (Prospective Studies)
STUDY DESIGNS IN CANCER EPIDEMIOLOGY

Descriptive Studies

Case-Control Study (Retrospective)

Cohort Study (Prospective)
GOALS OF DESCRIPTIVE EPIDEMIOLOGY

- Evaluation of trends in health
  - comparison of populations

- Basis for planning, provision, and evaluation of health services
  - public health administration

- Generation of hypotheses for investigation of disease etiology
  - analytic epidemiology
PREVALENCE

The number of affected persons present in the population divided by the number of people in the population.

\[
\text{Prevalence} = \frac{\text{Number of cases}}{\text{Number of people in the population}}
\]

- Good for looking at the burden of disease
- Valuable for planning
- **Not** useful for determining what caused disease
In 2008, a large metropolitan area estimated there were 250,000 residents over age 20 with type 2 diabetes. The Census bureau estimated that the population in the metropolitan area over age 20 was 5,030,250.

Prevalence = \( \frac{250,000}{5,030,250} = 0.0497 \)

In 2008, the prevalence of diabetes in the metropolitan area was 4.97%

Can also be expressed at 49.7 (50) cases per 1,000 residents over 20 years of age.
INCIDENCE

The number of new cases of disease that occur during a specified period of time divided by the number of persons at risk of developing the disease during the same period of time

\[
\text{Incidence} = \frac{\text{No. of new cases of disease over a specific period of time}}{\text{No. of persons at risk of disease over that specific period of time}}
\]

- Good for looking at the burden of disease
- Valuable for planning
- **Not** useful for determining what caused disease
A study in 2011 examined depression among women newly diagnosed with breast cancer. The study recruited 201 women. Of the 201, 21 had a prior diagnosis of depression. Over the first year, 7 of these women developed depression.

\[
\text{Incidence} = \frac{7}{201-21} = \frac{7}{180} = 0.0389
\]

The one year incidence of depression among study participants is 3.89%.

Can also be expressed as 38.9 (39) cases by 1,000 persons with breast cancer.
## RELATIVE RISK

Risk of disease among those who are exposed to those who are unexposed.

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Disease</th>
<th>Yes</th>
<th>No</th>
<th>Risk of disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>90 (a)</td>
<td>40  (b)</td>
<td>[\frac{a}{a+b} = \frac{90}{130}]</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>10 (c)</td>
<td>60  (d)</td>
<td>[\frac{c}{c+d} = \frac{10}{70}]</td>
<td></td>
</tr>
</tbody>
</table>

\[
RR = \frac{a/(a+b)}{c/(c+d)} = \frac{90/130}{10/70} = 4.85
\]

95% Confidence Interval
- \(4.85 (1.5-7)^*\)
- \(4.85 (0.7- 22.1) \text{ ns}\)
Ratio of odds of exposure among those who are with disease to those who are without disease.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Exposure</th>
<th>Yes</th>
<th>No</th>
<th>Odds of exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td></td>
<td>90 (a)</td>
<td>10 (b)</td>
<td>( \frac{a}{b} = \frac{90}{10} )</td>
</tr>
<tr>
<td>No</td>
<td></td>
<td>40 (c)</td>
<td>60 (d)</td>
<td>( \frac{c}{d} = \frac{40}{60} )</td>
</tr>
</tbody>
</table>

\[
\text{OR} = \frac{a/b}{c/d} = \frac{ad}{bc} = \frac{90 \times 60}{10 \times 40} = 13.5
\]

95% Confidence Interval

13.5 (10-15)* \hspace{1cm} 13.5 (0.7-22.1) ns
NATURAL HISTORY OF CANCER AND RELATED DATA SOURCES

- Disease Onset
- Symptoms
- Care Seeking
- Diagnosis
- Treatment
- Recurrence
- Death

Selected data sources

- Screening test results
- Medical Records
- Hospital Records
- Cancer Registry
- Death Certificates
CANCER DATA SOURCES

Surveillance Epidemiology and End Results (NCI)
(http://seer.cancer.gov/)

- Primary source of cancer statistics in United States began in 1973
- Collects information on incidence, prevalence, and survival from specific geographic areas representing 28% of US popln.
- Composed of 17 population-based cancer registries (Alaska Native Tumor Registry, Arizona Indians, Cherokee Nation, Connecticut, Detroit, Atlanta, Greater Georgia, Rural Georgia, San Francisco-Oakland, San Jose-Monterey, Greater California, Hawaii, Iowa, Kentucky, Los Angeles, Louisiana, New Jersey, New Mexico, Seattle-Puget Sound, Utah.
- Compiles reports on all these plus cancer mortality for entire country.

- World’s largest, on-going telephone health survey system, tracking health conditions and risk behaviors in the United States yearly since 1984. More than 350,000 adults are interviewed each year.

- Since 2011, use of a new sampling frame that includes both landline and cell phone households

- Currently, data are collected monthly in all 50 states, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and Guam.

- States use BRFSS data to identify emerging health problems, establish and track health objectives, and develop and evaluate public health policies and programs. Many states also use BRFSS data to support health-related legislative efforts.
CANCER PREVENTION

- Cancer caused by a variety of factors over a number of years
- Important to follow national trend data to monitor trends in factors that influence likelihood of getting cancer
- Focus on behavioral factors, environmental, policy/regulatory effects
- Approximately 50-75% of cancer deaths in the US are caused by human behaviors such as smoking, physical inactivity, and poor dietary choices.
Smoking causes about 30% of all US deaths from cancer and is single most important risk factor for cancer.

Cigarette smoking causes cancers of the lung, larynx, mouth, esophagus, pharynx, and bladder. In addition, it plays a role in acute myeloid leukemia and cancers of the pancreas, kidney, cervix, stomach, and liver.
Tobacco Use in the US, 1900-2009

Trends in Tobacco Use and Lung Cancer Death Rates* in the US

*Age-adjusted to 2000 US standard population.

TRENDS IN CIGARETTE SMOKING PREVALENCE* (%), BY SEX, ADULTS 18 AND OLDER, US, 1965-2011

PERCENTAGE OF ADULTS AGED 18 YEARS AND OLDER WHO WERE CURRENT CIGARETTE SMOKERS, 1991-2006

Source: Centers for Disease Control and Prevention, National Center for Health Statistics. National Health Interview Survey.
Data are age-adjusted to the 2000 standard using age groups: 18-24, 25-34, 35-44, 45-64, 65+.

Figure PAS4: Percentage of adults aged 25+ years and older who were current cigarette smokers by highest level of education obtained: 1991-2010.

Source: Centers for Disease Control and Prevention, National Center for Health Statistics. National Health Interview Survey. Data are age-adjusted to the 2000 US standard population using age groups: 25-34, 35-44, 45-64, 65+. 
CURRENT* CIGARETTE SMOKING PREVALENCE (%) AMONG HIGH SCHOOL STUDENTS BY SEX AND RACE/ETHNICITY, US, 1991-2009

*Smoked cigarettes on one or more of the 30 days preceding the survey.
INITIATION OF CIGARETTE USE AMONG CHILDREN, ADOLESCENTS, AND YOUNG ADULTS, US, 2002-2010

Source: Substance Abuse and Mental Health Services Administration, National Household Survey on Drug Use and Health. Data are not age-adjusted.
Diets rich in plant foods such as fruits and vegetables are associated with lower risk of cancers of the mouth, pharynx, larynx, esophagus, stomach, lung, and there is some evidence for colon, pancreas, and prostate.

A diet high in fruits and vegetables helps to reduce calorie intake and may help to control weight.

4 to 13 servings of fruits and vegetables daily, depending on energy needs. This includes 2 to 5 servings of fruits and 2 to 8 servings of vegetables, with emphasis on dark-green and orange vegetables and legumes.
TRENDS IN CONSUMPTION OF FIVE OR MORE RECOMMENDED VEGETABLE AND FRUIT SERVINGS FOR CANCER PREVENTION, ADULTS 18 AND OLDER, US, 1994-2005

Note: Data from participating states and the District of Columbia were aggregated to represent the United States.

AVERAGE CUPS OF FRUIT AND VEGETABLES CONSUMED PER 1,000 CALORIES BY INDIVIDUALS 2 AND OLDER: 1994-2004
DEMOGRAPHICS OF FRUIT AND VEGETABLE CONSUMPTION

- Fruit consumption is highest among the youngest and oldest segments of the population.

- Total fruit and vegetable consumption tends to increase with age, education and income.

- Among racial and ethnic groups, Blacks have the lowest intake and Mexican Americans have the highest.
Red meat/processed meat are associated with increased risk of colorectal cancer, with some evidence for other cancers, such as prostate.

Some research has suggested that processed, but not fresh meat may increase risk.

The increased risk may be due to the iron and fat in red meat, and/or the salt and nitrates/nitrites in processed meat.

Additionally, when meat is cooked at high temperatures, substances are formed that may be mutagenic or carcinogenic.
AVERAGE DAILY OUNCES OF RED MEAT CONSUMED BY INDIVIDUALS AGED 2 YEARS AND OLDER: 1994-2004


Alcohol intake increases risk of cancers of the mouth, esophagus, pharynx, larynx, and liver in men and women, and of breast cancer in women. Heavy use may also increase risk of colorectal cancer.

The earlier long-term, heavy alcohol use begins, the greater the cancer risk.

Using alcohol with tobacco is riskier than using either one alone because it further increases the chances of getting cancers of the mouth, throat, and esophagus.
ANNUAL PER CAPITA ALCOHOL CONSUMPTION IN GALLONS BY INDIVIDUALS 14 YEARS AND OLDER: 1990-2009

**Figure PAC1: Annual per capita alcohol consumption in gallons by individuals aged 14 years and older: 1990-2009**


Data are not age-adjusted.
Many people start drinking as early as middle school (aged 13–14 years).

Among those aged 12–17 years, Whites and Hispanics are more likely than Blacks to use alcohol.

Among alcohol drinkers, those aged 18–25 years consume greater quantities than any other group.
Physical activity at work or during leisure time is linked to a 30-percent lower risk of getting colon cancer, lower risk of breast cancer, and possibly lung and endometrial cancer.

Physical activity improves quality of life among cancer patients and survivors. Studies are beginning to explore the potential for physical activity to improve cancer survival.

Physical activity appears to be effective in reducing the amount of weight gained during and after treatment of breast cancer.
PERCENTAGE OF ADULTS AGED 18 YEARS AND OLDER REPORTING NO PHYSICAL ACTIVITY IN THEIR LEISURE TIME BY RACE/ETHNICITY: 1997-2010

Source: Centers for Disease Control and Prevention, National Center for Health Statistics. National Health Interview Survey. Data are age-adjusted to the 2000 US standard population using age groups: 18-24, 25-34, 35-44, 45-64, 65+. 
PERCENTAGE OF ADULTS AGED 18 YEARS AND OLDER REPORTING NO PHYSICAL ACTIVITY IN THEIR LEISURE TIME BY POVERTY INCOME LEVEL: 1997-2010

Figure PPA3: Percentage of adults aged 18 years and older reporting no physical activity in their leisure time by poverty income level: 1997-2010

Source: Centers for Disease Control and Prevention, National Center for Health Statistics. National Health Interview Survey. Data are age-adjusted to the 2000 US standard population using age groups: 18-24, 25-34, 35-44, 45-64, 65+. 
TRENDS IN PREVALENCE (%) OF NO LEISURE-TIME PHYSICAL ACTIVITY, BY EDUCATIONAL ATTAINMENT, ADULTS 18 AND OLDER, US, 1992-2009

Note: Data from participating states and the District of Columbia were aggregated to represent the United States. Educational attainment is for adults 25 and older.

TRENDS IN PREVALENCE (%) OF HIGH SCHOOL STUDENTS ATTENDING PE CLASS DAILY, BY GRADE, US, 1991-2009

Source: Youth Risk Behavior Surveillance System, 1991-2009 National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention, 2010
DEMOGRAPHICS OF PHYSICAL ACTIVITY

- Women are more likely than men to not engage in leisure-time physical activity.

- Blacks and Hispanics are more likely than Whites, to report no leisure-time physical activity.

- Lack of physical activity also is more common among those with less education and those with lower incomes.

- For youth, physical activity is lower among females, especially Blacks. Also, physical activity decreases as children get older.
OVERWEIGHT AND OBESITY

- Obesity associated with increased risk of many common cancers, such as colon, postmenopausal breast, uterine, esophageal, and renal cell cancers.

- Recent studies indicate that obesity and being overweight may increase the risk of death from many cancers, accounting for up to 14 percent of cancer deaths in men and 20 percent of cancer deaths in women.

- Weight groups are defined by BMI.
  
  Healthy weight - BMI between 18.5 and 24.9
  Overweight - BMI between 25.0 and 29.9
  Obese - BMI equal to or greater than 30.0
PERCENTAGE OF ADULTS AGED 20 -74 YEARS WHO WERE AT HEALTHY WEIGHT, OVERWEIGHT, OR OBESE, 1971-2010.
TRENDS IN OBESITY* PREVALENCE (%), BY GENDER, ADULTS AGED 20 TO 74, US, 1960-2010

*Obesity=body mass index ≥ 30 kg/m²; estimates are age adjusted to the 2000 US standard population. Source: National Health and Nutrition Examination Survey, National Center for Health Statistics, Centers for Disease Control and Prevention.
TRENDS IN OVERWEIGHT AND OBESITY* PREVALENCE (%), ADULTS 18 AND OLDER, US, 1992-2010

*Body mass index $\geq 25.0$ kg/m². Source: Behavioral Risk Factor Surveillance System, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention.
Overweight and obesity are most common among Black and Mexican American women. The same patterns are seen for children and teens in these groups.

Overweight children are more likely to become overweight adults. As with adults, the trend toward excess weight among children has greatly increased in recent years.
2013 ESTIMATED US CANCER CASES*

Estimated New Cancer Cases* in the US in 2013

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prostate</td>
<td>28%</td>
<td>29%</td>
</tr>
<tr>
<td>Lung &amp; bronchus</td>
<td>14%</td>
<td>14%</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>9%</td>
<td>9%</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>Melanoma of skin</td>
<td>5%</td>
<td>6%</td>
</tr>
<tr>
<td>Kidney &amp; renal pelvis</td>
<td>5%</td>
<td>4%</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>Oral cavity</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Leukemia</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Pancreas</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>All Other Sites</td>
<td>20%</td>
<td>19%</td>
</tr>
</tbody>
</table>

*Excludes basal cell and squamous cell skin cancers and in situ carcinoma except urinary bladder.
### The Lifetime Probability of Developing Cancer for Men, 2007-2009*

<table>
<thead>
<tr>
<th>Site</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>All sites†</td>
<td>1 in 2</td>
</tr>
<tr>
<td>Prostate</td>
<td>1 in 6</td>
</tr>
<tr>
<td>Lung and bronchus</td>
<td>1 in 13</td>
</tr>
<tr>
<td>Colon and rectum</td>
<td>1 in 19</td>
</tr>
<tr>
<td>Urinary bladder‡</td>
<td>1 in 26</td>
</tr>
<tr>
<td>Melanoma §</td>
<td>1 in 35</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>1 in 43</td>
</tr>
<tr>
<td>Kidney</td>
<td>1 in 49</td>
</tr>
<tr>
<td>Leukemia</td>
<td>1 in 63</td>
</tr>
<tr>
<td>Oral Cavity</td>
<td>1 in 66</td>
</tr>
<tr>
<td>Stomach</td>
<td>1 in 92</td>
</tr>
</tbody>
</table>

* For those free of cancer at beginning of age interval.
† All sites exclude basal and squamous cell skin cancers and in situ cancers except urinary bladder.
‡ Includes invasive and in situ cancer cases
§ Statistic for white men.

The Lifetime Probability of Developing Cancer for Women, 2007-2009*

<table>
<thead>
<tr>
<th>Site</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>All sites†</td>
<td>1 in 3</td>
</tr>
<tr>
<td>Breast</td>
<td>1 in 8</td>
</tr>
<tr>
<td>Lung &amp; bronchus</td>
<td>1 in 16</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>1 in 21</td>
</tr>
<tr>
<td>Uterine corpus</td>
<td>1 in 38</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>1 in 52</td>
</tr>
<tr>
<td>Urinary bladder‡</td>
<td>1 in 87</td>
</tr>
<tr>
<td>Melanoma§</td>
<td>1 in 54</td>
</tr>
<tr>
<td>Ovary</td>
<td>1 in 72</td>
</tr>
<tr>
<td>Pancreas</td>
<td>1 in 69</td>
</tr>
<tr>
<td>Uterine cervix</td>
<td>1 in 147</td>
</tr>
</tbody>
</table>

* For those free of cancer at beginning of age interval.
† All sites exclude basal and squamous cell skin cancers and in situ cancers except urinary bladder.
‡ Includes invasive and in situ cancer cases.
§ Statistic for white women.
CANCER INCIDENCE RATES* BY SEX, US, 1975-2009

*Age-adjusted to the 2000 US standard population and adjusted for delays in reporting.
CANCER INCIDENCE RATES* AMONG MEN, US, 1975-2009


CANCER INCIDENCE RATES* BY SEX AND RACE, US, 1975-2009

Cancer Incidence Rates* by Sex and Race, US, 1975-2009

*Age-adjusted to the 2000 US standard population.
Cancer Incidence Rates* by Race and Ethnicity, 2005-2009

*Age-adjusted to the 2000 US standard population.
†Persons of Hispanic origin may be of any race.
Cancers can be diagnosed at different stages in their development. Stage of cancer diagnosis may be expressed as numbers (I, II, III, or IV, for example) or by terms such as "localized," "regional," and "distant."

The lower the number or the more localized the cancer, the better a person's chances of benefiting from treatment and being cured.

Tracking the rates of late-stage (distant) cancers is a good way to monitor the impact of cancer screening. When more cancers are detected in early stages, fewer should be detected in late stages.

A lower rate of diagnosis at late stages is an early sign of the effectiveness of cancer screening efforts. These lower rates can be expected to occur before decreases in death rates are seen.
RATES OF NEW CANCERS OF DISTANT STAGE DISEASES BY CANCER SITE: 1980-2008

Figure DST1: Rates of new cancers of distant stage diseases by cancer site: 1980-2008

Figure DST2: Rates of new late stage breast cancer: 1980-2008

Advances in the ways that cancer is diagnosed and treated have increased the number of people who live disease-free for long periods of time.

More and more people are benefiting from the early detection of cancer and its successful treatment. These medical advances are improving both quality of life and length of survival.

National data regarding life after cancer are limited and include survival rates by each stage at diagnosis, economic impact of cancer, cancer survivor’s smoking status.
WHO ARE CANCER SURVIVORS?

- Any person who has been diagnosed with cancer, from the time of diagnosis through the balance of life.
- In practice, concept of survivorship often associated with period after active treatment ends.

3 Distinct Phases of Cancer Survival

- Diagnosis to end of initial treatment
- Transition from treatment to extended survival
- Long-term survival
Dr Rowland talks to ecancertv at the European Breast Cancer Conference, Vienna, March 2012, about the developing field of cancer survivorship.

http://ecancer.org/tv/conference/140/1333
RANGE OF CANCER EXPERIENCES AMONG SURVIVORS

- Cancer-free
- ≥1 late treatment complication
- Dying after late recurrence
- Second cancer
- Intermittent periods of active disease requiring treatment
- Continuous cancer without disease-free period
As of January 1, 2012, it is estimated that there are 13.7 million cancer survivors (~4% of the population) increased from 3 million (1.5%) in 1971.

Increasing number of survivors due to:

- Aging and growth of population
- Improved survival rates

Invasive/1st Primary Cases Only
ESTIMATED NUMBER OF US CANCER SURVIVORS BY SITE IN 2012 AND 2022

As of January 1, 2012

Male
- Prostate: 2,778,630 (43%)
- Colon & rectum: 595,210 (9%)
- Melanoma: 481,040 (7%)
- Urinary bladder: 437,180 (7%)
- Non-Hodgkin lymphoma: 279,500 (4%)
- Testis: 230,910 (4%)
- Kidney & renal pelvis: 213,000 (3%)
- Lung & bronchus: 189,080 (3%)
- Oral cavity & pharynx: 185,240 (3%)
- Leukemia: 167,740 (3%)
- All sites: 6,442,280

Female
- Breast: 2,971,610 (41%)
- Uterine corpus: 606,910 (8%)
- Colon & rectum: 603,530 (8%)
- Melanoma: 496,210 (7%)
- Thyroid: 436,590 (6%)
- Non-Hodgkin lymphoma: 255,450 (4%)
- Uterine cervix: 245,020 (3%)
- Lung & bronchus: 223,150 (3%)
- Ovary: 192,750 (3%)
- Urinary bladder: 148,210 (2%)
- All sites: 7,241,570

As of January 1, 2022

Male
- Prostate: 3,922,600 (45%)
- Colon & rectum: 751,590 (9%)
- Melanoma: 661,980 (8%)
- Urinary bladder: 548,870 (6%)
- Non-Hodgkin lymphoma: 371,980 (4%)
- Kidney & renal pelvis: 300,800 (3%)
- Testis: 295,590 (3%)
- Oral cavity & pharynx: 232,330 (3%)
- Lung & bronchus: 231,380 (3%)
- Ovary: 229,020 (2%)
- Kidney & renal pelvis: 208,250 (2%)
- All sites: 8,796,830

Female
- Breast: 3,786,610 (41%)
- Colon & rectum: 735,720 (8%)
- Uterine corpus: 725,870 (8%)
- Melanoma: 662,280 (7%)
- Thyroid: 609,690 (7%)
- Non-Hodgkin lymphoma: 341,830 (4%)
- Lung & bronchus: 277,800 (3%)
- Uterine cervix: 244,210 (3%)
- Kidney & renal pelvis: 208,250 (2%)
- All sites: 9,184,550
Majority of cancer (64%) diagnosed 5 or more years ago.
15% diagnosed 20 or more years ago.
71% of survivors are currently 60 years of age and older.
Almost half (45%) are age 70 years of age or older.
Only 5% are younger than 40 years of age.
TRENDS IN FIVE-YEAR RELATIVE SURVIVAL (%)* RATES, US, 1975-2008

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>All sites</td>
<td>49</td>
<td>56</td>
<td>68</td>
</tr>
<tr>
<td>Breast (female)</td>
<td>75</td>
<td>84</td>
<td>90</td>
</tr>
<tr>
<td>Colon</td>
<td>51</td>
<td>61</td>
<td>65</td>
</tr>
<tr>
<td>Leukemia</td>
<td>34</td>
<td>43</td>
<td>58</td>
</tr>
<tr>
<td>Lung &amp; bronchus</td>
<td>12</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>Melanoma</td>
<td>82</td>
<td>88</td>
<td>93</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>47</td>
<td>51</td>
<td>71</td>
</tr>
<tr>
<td>Ovary</td>
<td>36</td>
<td>38</td>
<td>43</td>
</tr>
<tr>
<td>Pancreas</td>
<td>2</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Prostate</td>
<td>68</td>
<td>83</td>
<td>100</td>
</tr>
<tr>
<td>Rectum</td>
<td>48</td>
<td>58</td>
<td>68</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>73</td>
<td>79</td>
<td>80</td>
</tr>
</tbody>
</table>

Five-year Relative Cancer Survival Rates (%) by Race, 2002-2008

<table>
<thead>
<tr>
<th>Site</th>
<th>White</th>
<th>African American</th>
<th>Absolute Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Sites</td>
<td>66</td>
<td>58</td>
<td>8</td>
</tr>
<tr>
<td>Breast (female)</td>
<td>90</td>
<td>78</td>
<td>12</td>
</tr>
<tr>
<td>Colon</td>
<td>64</td>
<td>56</td>
<td>8</td>
</tr>
<tr>
<td>Esophagus</td>
<td>18</td>
<td>11</td>
<td>7</td>
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<tr>
<td>Leukemia</td>
<td>55</td>
<td>48</td>
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</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
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<td>8</td>
</tr>
<tr>
<td>Oral cavity</td>
<td>63</td>
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<tr>
<td>Prostate</td>
<td>100</td>
<td>96</td>
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<td>Rectum</td>
<td>67</td>
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</tr>
<tr>
<td>Urinary bladder</td>
<td>78</td>
<td>64</td>
<td>14</td>
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<tr>
<td>Uterine cervix</td>
<td>69</td>
<td>59</td>
<td>10</td>
</tr>
<tr>
<td>Uterine corpus*</td>
<td>84</td>
<td>60</td>
<td>24</td>
</tr>
</tbody>
</table>

5-year relative survival rates based on patients diagnosed from 2002 to 2008, all followed through 2009.
*Includes uterus, NOS (not otherwise specified).
In 2012, estimated 2.9 million women living in US with history of invasive BrCa

- Median age at Dx is 61
- 20% of BrCa occurs in women ≤50 yrs; 40% in women ≥ 65 yrs
- 60% of BrCa diagnosed at localized stage, 2001-07
SPECIAL CONCERNS AMONG BREAST CANCER SURVIVORS

- 10 to 50% of patients develop lymphedema of the arm as a side effect of surgery and radiation
  - Use of sentinel lymph node biopsy, rather than axillary lymph node dissection reduces risk.
  - Some evidence that upper body exercise and physical activity may reduce risk.
- Numbness or tightness, pulling, stretching in the chest wall, arms, or shoulders
- Premature menopause, impaired fertility among younger patients
- Increased risk of osteoporosis
- Treatment with aromatase inhibitors can cause muscle pain, joint stiffness and/or pain, osteoporosis.
Vitamin D deficiency is more prominent among cancer patients. Approximately 75% of American breast cancer patients have 25(OH)D levels less than 30 ng/ml.

Vitamin D is a co-factor in synthesis of serotonin, dopamine, and norepinephrine.

Low plasma vitamin D levels may be associated with greater risk of:

- Depression
- Cognitive Impairment
- Lower quality of life in women without cancer
- May help to prevent Alzheimer’s Disease and Parkinson’s Disease

<table>
<thead>
<tr>
<th>Categories of Circulating 25(OH)D Levels (ng/ml)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20</td>
<td>Deficient</td>
</tr>
<tr>
<td>20-30</td>
<td>Insufficient</td>
</tr>
<tr>
<td>&gt;30</td>
<td>Sufficient</td>
</tr>
</tbody>
</table>
Prospective study of 504 new, incident breast cancer patients being treated at Roswell Park Cancer Institute.

Participants fill out a self-administered study questionnaires.
- Mental and physical health (SF36)
- Perceived stress scale
- Center for Epidemiologic studies depression scale
- Multidimensional Assessment of Fatigue Scale

Serum 25(OH)D levels measured by immunochemiluminescent assay at time of diagnosis prior to treatment and 12 months later in 372 women.

Clinical data from Surgical Oncology Breast Database
- Serum 25(OH) D levels adjusted for seasonal effects using locally weighted polynomial regression models

- QoL variables examined were SF36 aggregate mental component (below vs above median), SF36 aggregate physical component (below vs above median), perceived stress (above vs below median), depression (high vs low, ≥16 vs <16), and fatigue (above vs below median).

- All multivariable logistic regression models adjusted for age, race, BMI at diagnosis, smoking status, education, AJCC Stage, and ER status. Models of QoL one year post-diagnosis were additionally adjusted for baseline scores.

- Sensitivity analysis examining relationships only among women who do not use vitamin D supplements
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Frequency (N=504)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age, years</strong></td>
<td></td>
</tr>
<tr>
<td>&lt;50</td>
<td>139 (27.6%)</td>
</tr>
<tr>
<td>≥50</td>
<td>365 (72.4%)</td>
</tr>
<tr>
<td><strong>Menopausal Status</strong></td>
<td></td>
</tr>
<tr>
<td>Premenopausal</td>
<td>177 (35.1%)</td>
</tr>
<tr>
<td>Postmenopausal</td>
<td>327 (64.9%)</td>
</tr>
<tr>
<td><strong>Race</strong></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>466 (92.5%)</td>
</tr>
<tr>
<td>African American</td>
<td>30 (6.0%)</td>
</tr>
<tr>
<td>Other</td>
<td>8 (1.6%)</td>
</tr>
<tr>
<td><strong>Stage</strong></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>70 (13.9%)</td>
</tr>
<tr>
<td>I</td>
<td>256 (50.8%)</td>
</tr>
<tr>
<td>IIA</td>
<td>103 (20.4%)</td>
</tr>
<tr>
<td>≥IIIA</td>
<td>75 (14.9%)</td>
</tr>
<tr>
<td><strong>ER status</strong></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>386 (76.6%)</td>
</tr>
<tr>
<td>Negative</td>
<td>104 (20.6%)</td>
</tr>
<tr>
<td>Not determined</td>
<td>14 (2.8%)</td>
</tr>
<tr>
<td><strong>Circulating 25(OH)D, ng/ml</strong></td>
<td></td>
</tr>
<tr>
<td>&lt;20</td>
<td>160 (31.7%)</td>
</tr>
<tr>
<td>20 to ≤30</td>
<td>215 (42.6%)</td>
</tr>
<tr>
<td>&gt;30</td>
<td>129 (25.6%)</td>
</tr>
</tbody>
</table>
Analysis were adjusted for age, race, menopausal status, BMI, smoking status, education, breast cancer stage, ER status, duration of sample storage, and season of draw.
CIRCULATING 25(OH) D LEVELS AT DIAGNOSIS AND QOL ONE YEAR POST DIAGNOSIS (N=372)

Analysis were adjusted for age, race, menopausal status, BMI, smoking status, education, breast cancer stage, ER status, duration of sample storage, and season of draw.

<table>
<thead>
<tr>
<th>Categories of Circulating 25(OH)D Levels (ng/ml)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20</td>
<td>Deficient</td>
</tr>
<tr>
<td>20-30</td>
<td>Insufficient</td>
</tr>
<tr>
<td>&gt; 30</td>
<td>Sufficient</td>
</tr>
</tbody>
</table>

Figure 3. Circulating 25(OH) D levels and QoL One Year Post Diagnosis (N=372)
Breast cancer survivors with insufficient or deficient circulating 25(OH) D levels were more likely to report poor QoL compared to women with sufficient levels. Maintenance of optimal vitamin D levels may help to improve breast cancer patients’ QoL as they go through breast cancer treatment.
Study Aims

Obesity, related comorbidities, and breast cancer outcomes in African Americans (R01CA185623)

Elisa Bandera
Rutgers CINJ

Chi-Chen Hong
RPCI

Kitaw Demissie
Rutgers School of Public Health

Circle of Joy ©2013, Keith Mallet, used with permission of the artist
Methods

Women’s Circle of Health Study
R01 CA100598 (Ambrosone, Bandera)
P01 CA151135 (Ambrosone, Palmer, Olshan)
Case-control study for breast cancer risk

WCHS Follow-Up Study
Prospective Observational Cohort of 1,700 WCHS Invasive AA Cases

WCHS
- Funded to recruit AA cases in NJ to 08/2015
- Interview for breast cancer risk factors
- Saliva collection
- Anthropometrics

WCHS INVASIVE AA CASES
- Total expected by 12/2018: 1,700

F/U 1 & F/U 2
Home Visits
- 18 and 30 mo post-diagnosis
- Blood collection
- Survey interview
- Anthropometrics
- Blood pressure

F/U 3 & F/U 4
Telephone Survey
- 42 and 54 mo post-diagnosis

Outcomes
- Mortality outcomes (N=1,700)
- Quality-of-Life (N=1,100)

Medical and pharmacy record reviews; biological assays of follow-up bloods collected (N=1,100); genotyping for genomic ancestry markers; linkage with NJ Cancer Registry
PROSTATE CANCER

- 2.8 M men living with a history of prostate cancer in US
- Additional 241,740 estimated cases in 2012.
- Median age at Dx is 67
- Most men diagnosed by PSA screening, although expert groups conclude data is insufficient to recommend routine use of PSA.
- >90% of all prostate cancers are discovered in the local or regional stages for which the 5-yr mortality rate is 100%.
- 10 and 15 yr survival rate is 97.8% and 91.4%, respectively.
Survivors treated with surgery or radiation therapy experience incontinence, erectile dysfunction, bowel complications.

Patients receiving hormonal treatment may experience loss of libido, menopausal-like symptoms including hot flashes, night sweats, irritability, and osteoporosis.

Over long-term, hormone therapy increases risk of diabetes, cardiovascular disease, obesity.
1% of all new cancers (birth to age 14)
2nd leading cause of death in children (accidents is 1st)
58,510 childhood cancer survivors in US
~12,060 will be diagnosed in 2012.
5-year survival rate has improved over past 30 yrs due to new and improved treatments,
Children may experience treatment-related side effects many years after diagnosis.

Aggressive treatments used during 1970s and 80s, and even some newer treatments, result in a number of late effects, including risk of second cancers, organ dysfunction, reduced growth and development, decreased fertility, cognitive impairments, early death.

Most common second cancers are breast, brain/CNS, bone, thyroid soft tissue, melanoma, acute myeloid leukemia.
SPECIAL CONCERNS OF CHILDHOOD CANCER SURVIVORS

- Radiation to brain or spine can slow growth. If “at risk” for being short, healthcare provider can recommend tests and treatments.
- Survivors treated with chest radiation or anthracyclines might have heart problems. More likely at higher doses and if treatment occurred before heart finished growing.
- Radiation and some anticancer drugs affect sexual development and reproduction. Risk of delayed puberty, infertility, early menopause.
- Adolescents and young adults face additional challenges related to insurance coverage.
- Medicaid covers cancer treatment for pediatric cancer patients meeting income criteria, but more general coverage lapses at age 18 or 21 depending on state of residence.
Management of cancer and treatment-related symptoms is an important aspect of cancer care, affecting QOL, functional status, and completion of treatment.

Most common side-effects:
- Pain
- Fatigue
- Emotional distress
- Bone density
- Cardiotoxicity
- Cognitive Deficits
IOM’S QUALITY OF LIFE MODEL

The Institute of Medicine’s Quality of Life Model

Psychological
• Distress of Diagnosis & Control of Treatment
• Control
• Anxiety
• Depression
• Enjoyment/Leisure
• Fear of Reoccurrence
• Cognition/Attention

Physical
• Functional activities
• Strength/Fatigue
• Sleep and Rest
• Fertility
• Pain
• Overall Physical Health

Social
• Family Distress
• Roles and Relationships
• Affection/Sexual Function
• Appearance
• Enjoyment
• Isolation
• Finances
• Work

Spiritual
• Meaning of illness
• Religiosity
• Transcendence
• Hope
• Uncertainty
• Inner Strength


Slide from Jennifer Hydeman
PAIN

Pain (ACS Cancer Facts & Figures 2007)

- One of most common symptoms associated with cancer and one of most important factors reducing QOL
- Associated with depression and poor functioning.
- Can interfere with normal activities, diminish enjoyment of everyday pleasures, prevent relaxation and sleep, increase anxiety, stress, and fatigue.
- Can cause people to withdraw and reduce contact with friends and family.
- Recent meta-analysis estimated prevalence of pain to be:
  - 59% undergoing active treatment
  - 33% after treatment
  - 64% with advanced/metastatic/terminal disease
Both surgery and radiation can cause nerve damage, resulting in chronic pain.

Chemotherapy drugs, especially vincristine and taxanes, can damage sensory nerve cells, causing peripheral neuropathy. Extent of damage is dose-dependent and may take months or years to resolve.

Regardless of stage of disease or recovery, ~ 80% of cancer-associated pain can be relieved by proper treatment.

Often undertreated (minorities, age 70 or older, female). Serious problem in developed countries. Even more serious in developing countries.
Clinical guidelines from WHO and NCCN recommend that doctors ask about pain and other symptoms throughout course of treatment and continuing care (eg. Wong-Baker FACES Pain Rating Scale)

Pharmacologic treatment of cancer pain provided by WHO’s Three-Step Analgesic Ladder
Use of Complementary Methods to help Control Pain

- Cognitive and behavioral techniques to divert attention from pain, improve pain tolerance.
- Accupuncture
- Mind-body imaging techniques (hypnosis, progressive muscle relaxation)
- Therapeutic massage

Issues with Reimbursement

- Lack of health insurance plays significant role in which pain is treated (47 million Americans have no health insurance).
- Depending on health insurance, some have full access to adequate pain management while others do not.
- Problems are worse for the most vulnerable populations – low SES, and racial and ethnic minorities, who have been shown to have a greater degree of pain and suffering from cancer than other Americans.
FATIGUE

- One of the most common side-effect of cancer treatment; reported in 28% to 90% of cancer patients.
- Reported by 80-90% of those receiving chemotherapy or radiation.
- Different from feeling tired after a long day and does not get better with rest or sleep.

- For many patients, chronic fatigue persists long after treatment has ended. At least 3 studies suggest that persistent fatigue is present in 17 to 26% of cancer survivors.
- Fatigue in cancer patients is underdiagnosed, underreported, and undertreated.
- Seldom occurs by itself. Commonly associated with sleep disturbance, emotional distress (depression, anxiety), or pain.
FATIGUE

Cause is multifactorial.

- Anemia
- Depression
- Chronic inflammatory processes with elevated cytokines
- Alterations in muscular energy systems

Meta-analyses show that exercise, especially moderate-intensity resistance exercise, reduces cancer-related fatigue.

Some evidence for the efficacy of psychological interventions or psychostimulants.
CANCER-RELATED DISTRESS

- Defined as a multifactorial unpleasant emotional experience of a psychosocial nature that may interfere with the ability to cope effectively with cancer and its treatment.

- Complex response to effects of pain, fatigue, and/or other stressors associated with cancer diagnosis and treatment.

- Difficult to identify because of overlap with other symptoms (eg. Fatigue, changes in appetite, sleep disruption).

- Recent meta-analysis found 30 to 40% of cancer patients with diagnosable mood disorder, though this is thought to be an underestimate.

- Early detection and treatment of distress can improve treatment adherence and patient-provider communication and decrease the risk of severe depression or anxiety.
CANCER-RELATED DISTRESS

- 2008 IOM report supported work of the National Comprehensive Cancer Network (NCCN) guidelines for Distress Management.

- Recommends routine screening for distress and has developed a measurement tool called the Distress Thermometer.

- Those with moderate to severe distress often referred to supportive services (mental health, social work, counseling).
Memory and Thinking Problems

- **Chemobrain**
  - Can negatively impact cognitive function, including problems with attention, concentration, memory, comprehension, mental speed processing, and reasoning.
  - Can be debilitating
  - Long-term survivors of breast, lung, and ovarian cancers and lymphoma may have cognitive and neurological complications caused by systemic therapy.
  - Study of brain dysfunction is complicated by chemo-related fatigue, depression, and anxiety which also contributes to poor cognitive performance.
  - Risk of cognitive impairment from chemo increases with advanced age, lower pretreatment IQ, and the apolipoprotein E genotype, which is associated with Alzheimer disease.
FEAR OF CANCER RECURRENCE

- Among chief concerns of posttreatment cancer survivors and may persist long after treatment ends, even among survivors who are considered to be cancer free or in remission.
- ACS Studies of Cancer Survivors indicate that ~60% of 1-year cancer survivors reported moderate to severe concerns about disease recurrence.
- Fear of recurrence is elevated among survivors and caregivers who find less meaning in the cancer experience and who experience more concomitant family stressors.

- Identified surveillance and applied research as major areas of public health focus for cancer survivorship.
- Recommended development of infrastructure for comprehensive database on cancer survivorship.
- Recommended improved coordination among administrators of existing databases and the addition of variables of indicators to collect supplementary information on cancer survivors.

Reports Recommending Cancer Survivorship Data Collection/Surveillance


- Emphasized the importance of surveillance in monitoring cancer treatment and factors associated with the ongoing health concerns of cancer survivors.
Established in 1984
Largest continuously conducted telephone health survey in the world
>355,710 interviews annually
50 states, District of Columbia, Puerto Rico, Virgin Islands, Guam
<table>
<thead>
<tr>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
</tr>
<tr>
<td>Health Status</td>
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<tr>
<td>Health Care Access</td>
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<tr>
<td>Healthy Days</td>
</tr>
<tr>
<td>Life Satisfaction</td>
</tr>
<tr>
<td>Emotional Support</td>
</tr>
<tr>
<td>Disability</td>
</tr>
<tr>
<td>Tobacco Use</td>
</tr>
<tr>
<td>Oral Health</td>
</tr>
<tr>
<td>Alcohol Consumption</td>
</tr>
<tr>
<td>Exercise</td>
</tr>
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<td>Immunization</td>
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<tr>
<td>HIV/AIDS</td>
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<tr>
<td>Diabetes</td>
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<td>Asthma</td>
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<td>Cardiovascular Disease</td>
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<td>Emerging Issues</td>
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<td>Cholesterol Awareness</td>
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<td>Arthritis Burden</td>
</tr>
<tr>
<td>Physical Activity</td>
</tr>
<tr>
<td>Fruits and Vegetables</td>
</tr>
</tbody>
</table>
Core Questions

1. Have you ever been told by a doctor, nurse, or other health care professional that you had cancer?

2. [If yes] At what age were you told that you had cancer?

3. How many different types of cancer have you had?

4. [If one] What type of cancer was it? [Or if more than one] With your most recent diagnosis of cancer, what type of cancer was it?
States may choose to ask 10 questions added as an optional module

Source of questions
- 1992 National Health Interview Survey Cancer Survivorship Supplement
- State CCC programs, CDC staff

Allowed state-level assessment of survivorship issues related to cancer treatment, pain, and access to care
- 2009: 4 states participated (Connecticut, North Carolina, Vermont, Virginia)
- 2010: 10 states participated (Alaska, Connecticut, Guam, Indiana, Massachusetts, Missouri, New Mexico, Ohio, South Dakota, Wisconsin)
1. Previously you said that you had been told by your doctor that you had cancer. I will now ask you about your experiences with cancer. Are you currently receiving treatment for cancer? By treatment, we mean surgery, radiation therapy, chemotherapy, or chemotherapy pills.

2. What type of doctor provides the majority of your health care? (cancer surgeon, family practitioner, etc)

3. Did any doctor, nurse, or other health professional EVER give you a written summary of all the cancer treatments that you received?

4. Have you EVER received instructions from a doctor, nurse, or other health professional about where you should return or who you should see for routine cancer check-ups after completing treatment for cancer?
5. Were these instructions written down or printed on paper for you?

6. With your most recent diagnosis of cancer, did you have health insurance that paid for all or part of your cancer treatment? (Note: "Health insurance" also includes Medicare, Medicaid, or other types of state health programs.)

7. Were you EVER denied health insurance or life insurance coverage because of your cancer?

8. Did you participate in a clinical trial as part of your cancer treatment?

9. Do you currently have physical pain caused by your cancer or cancer treatment?

10. Is your pain currently under control?
**Mortality.** The ultimate measure of success against cancer is how quickly and how far we can lower death rates.

The number of cancer deaths per 100,000 people per year, age-adjusted to a U.S. 2000 standard population.

**Person-years of life lost (PYLL).** The years of life lost due to early death from a particular cause or disease. PYLL due to cancer helps to describe the extent to which life is cut short by cancer. On average, each person who dies from cancer loses an estimated 15.5 years of life.
2013 ESTIMATED US CANCER DEATHS

Source: American Cancer Society, 2013.
# US Mortality, 2005

<table>
<thead>
<tr>
<th>Rank</th>
<th>Cause of Death</th>
<th>No. of deaths</th>
<th>% of all deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Heart Diseases</td>
<td>652,091</td>
<td>26.6</td>
</tr>
<tr>
<td>2.</td>
<td>Cancer</td>
<td>559,312</td>
<td>22.8</td>
</tr>
<tr>
<td>3.</td>
<td>Cerebrovascular diseases</td>
<td>143,579</td>
<td>5.9</td>
</tr>
<tr>
<td>4.</td>
<td>Chronic lower respiratory diseases</td>
<td>130,933</td>
<td>5.3</td>
</tr>
<tr>
<td>5.</td>
<td>Accidents (unintentional injuries)</td>
<td>117,809</td>
<td>4.8</td>
</tr>
<tr>
<td>6.</td>
<td>Diabetes mellitus</td>
<td>75,119</td>
<td>3.1</td>
</tr>
<tr>
<td>7.</td>
<td>Alzheimer disease</td>
<td>71,599</td>
<td>2.9</td>
</tr>
<tr>
<td>8.</td>
<td>Influenza &amp; pneumonia</td>
<td>63,001</td>
<td>2.6</td>
</tr>
<tr>
<td>9.</td>
<td>Nephritis*</td>
<td>43,901</td>
<td>1.8</td>
</tr>
<tr>
<td>10.</td>
<td>Septicemia</td>
<td>34,136</td>
<td>1.4</td>
</tr>
</tbody>
</table>

*Includes nephrotic syndrome and nephrosis.
CHANGE IN THE US DEATH RATES* BY CAUSE, 1950 & 2005

Rate Per 100,000

Heart Diseases: 211.1 (1950), 586.8 (2005)
Cerebrovascular Diseases: 46.6 (1950), 180.7 (2005)
Cancer: 193.9 (1950), 183.8 (2005)

* Age-adjusted to 2000 US standard population.
Sources: 1950 Mortality Data - CDC/NCHS, NVSS, Mortality Revised.
CANCER DEATH RATES* BY SEX, US, 1975-2009

*Age-adjusted to the 2000 US standard population. 
CANCER DEATH RATES* AMONG MEN, US, 1930-2009

Cancer Death Rates* Among Men, US, 1930-2009

*Age-adjusted to the 2000 US standard population.
National Center for Health Statistics, Centers for Disease Control and Prevention.
TOTAL NUMBER OF CANCER DEATHS AVOIDED FROM 1991 TO 2009 IN MEN AND 1992 TO 2009 IN WOMEN

Total Number of Cancer Deaths Averted from 1991 to 2009 in Men and 1992 to 2009 in Women

The blue line represents the actual number of cancer deaths recorded in each year, and the red line represents the number of cancer deaths that would have been expected if cancer death rates had remained at their peak.
CANCER SITES IN MEN FOR WHICH AFRICAN AMERICAN DEATH RATES* EXCEED WHITE DEATH RATES*, US, 2000-2004

<table>
<thead>
<tr>
<th>Site</th>
<th>AA</th>
<th>EA</th>
<th>Ratio of AA/EA</th>
</tr>
</thead>
<tbody>
<tr>
<td>All sites</td>
<td>321.8</td>
<td>234.7</td>
<td>1.4</td>
</tr>
<tr>
<td>Prostate</td>
<td>62.3</td>
<td>25.6</td>
<td>2.4</td>
</tr>
<tr>
<td>Larynx</td>
<td>5.0</td>
<td>2.2</td>
<td>2.3</td>
</tr>
<tr>
<td>Stomach</td>
<td>11.9</td>
<td>5.2</td>
<td>2.3</td>
</tr>
<tr>
<td>Myeloma</td>
<td>8.5</td>
<td>4.4</td>
<td>1.9</td>
</tr>
<tr>
<td>Oral cavity and pharynx</td>
<td>6.8</td>
<td>3.8</td>
<td>1.8</td>
</tr>
<tr>
<td>Small intestine</td>
<td>0.7</td>
<td>0.4</td>
<td>1.8</td>
</tr>
<tr>
<td>Liver and intrahepatic bile duct</td>
<td>10.0</td>
<td>6.5</td>
<td>1.5</td>
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<tr>
<td>Colon and rectum</td>
<td>32.7</td>
<td>22.9</td>
<td>1.4</td>
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<tr>
<td>Esophagus</td>
<td>10.2</td>
<td>7.7</td>
<td>1.3</td>
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<tr>
<td>Lung and bronchus</td>
<td>95.8</td>
<td>72.6</td>
<td>1.3</td>
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<tr>
<td>Pancreas</td>
<td>15.5</td>
<td>12.0</td>
<td>1.3</td>
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</tbody>
</table>

*Per 100,000, age-adjusted to the 2000 US standard population.
CANCER SITES IN WOMEN FOR WHICH AFRICAN AMERICAN DEATH RATES* EXCEED WHITE DEATH RATES*, US, 2000-2004

<table>
<thead>
<tr>
<th>Site</th>
<th>African American</th>
<th>White</th>
<th>Ratio of African American/White</th>
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<tbody>
<tr>
<td>All sites</td>
<td>189.3</td>
<td>161.4</td>
<td></td>
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<tr>
<td>Myeloma</td>
<td>6.3</td>
<td>2.8</td>
<td>2.4</td>
</tr>
<tr>
<td>Stomach</td>
<td>5.8</td>
<td>2.2</td>
<td>2.6</td>
</tr>
<tr>
<td>Uterine cervix</td>
<td>4.9</td>
<td>2.3</td>
<td>2.1</td>
</tr>
<tr>
<td>Esophagus</td>
<td>3.0</td>
<td>1.7</td>
<td>1.8</td>
</tr>
<tr>
<td>Uterine corpus</td>
<td>1.9</td>
<td>1.8</td>
<td>1.1</td>
</tr>
<tr>
<td>Small intestine</td>
<td>0.5</td>
<td>0.3</td>
<td>1.7</td>
</tr>
<tr>
<td>Larynx</td>
<td>0.8</td>
<td>0.5</td>
<td>1.6</td>
</tr>
<tr>
<td>Pancreas</td>
<td>12.4</td>
<td>9.0</td>
<td>1.4</td>
</tr>
<tr>
<td>Colon and rectum</td>
<td>22.9</td>
<td>15.9</td>
<td>1.5</td>
</tr>
<tr>
<td>Liver and intrahepatic bile duct</td>
<td>3.9</td>
<td>2.8</td>
<td>1.4</td>
</tr>
<tr>
<td>Breast</td>
<td>33.8</td>
<td>25.0</td>
<td>1.4</td>
</tr>
<tr>
<td>Gallbladder</td>
<td>1.9</td>
<td>0.8</td>
<td>2.4</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>2.8</td>
<td>2.3</td>
<td>1.2</td>
</tr>
<tr>
<td>Oral cavity and pharynx</td>
<td>1.7</td>
<td>1.5</td>
<td>1.1</td>
</tr>
</tbody>
</table>

*Per 100,000, age-adjusted to the 2000 US standard population.
TOTAL NUMBER OF PREMATURE (AGES 25 TO 64) CANCER DEATHS THAT COULD HAVE BEEN AVOIDED IN 2007 BY ELIMINATING ECONOMIC AND RACIAL DISPARITIES

- Level of education often used as marker for SES
- If death rates of most educated non-Hispanic white applied to all individuals ages 25 to 64 – i.e. if everyone had same cancer burden as most educated – number of deaths in this age group could be reduced by 37%.
Among AA aged 25-64, there were 12,710 cancer deaths in men and 11,850 deaths in women in 2007.

Eliminating economic disparities among AA could potentially avoid 10,050 cancer deaths, twice as many as eliminating racial disparities.
The difference between the actual age of death due to the disease/cause and the expected age of death.

Specifically, this measure is estimated by linking life table data to each death of a person of given age and sex.

The life table permits a determination of the number of additional years an average person of that age, race, and sex would have been expected to live.
PERSON-YEARS OF LIFE LOST IN THE US DUE TO MAJOR CAUSES OF DEATH. ALL RACES, BOTH SEXES: 2006

- Malignant Neoplasms: 8,628
- All Other Causes: 7,839
- Heart Disease: 7,285
- Accidents: 3,872
- Cerebrovascular: 1,475
- Chronic Lung Disease: 1,443
- Suicide & Self-Inflicted Injury: 1,132
- Diabetes Mellitus: 1,046
- Homicide: 869
- Cirrhosis: 620
- Pneumonia & Influenza: 572
- Nephritis & Nephrosis: 536
- Septicemia: 478
- Alzheimers Disease: 472
- HIV: 406
- Aortic Aneurysm & Dissection: 169
- Atherosclerosis: 68

PERSON-YEARS OF LIFE LOST IN THE US DUE TO CANCER, ALL RACES, MALES: 2006

- Lung & Bronchus: 1,274
- Colon & Rectum: 382
- Prostate: 263
- Pancreas: 246
- Leukemia: 200
- Liver & IBD: 188
- Esophagus: 172
- Non-Hodgkin Lymphoma: 161
- Brain & ONS: 157
- Kidney & Renal Pelvis: 120
- Urinary Bladder: 104
- Stomach: 101
- Melanoma of the Skin: 94
- Oral Cavity & Pharynx: 93
- Myeloma: 76
- Childhood Ages (0-14): 52
- Hodgkin Lymphoma: 19
- Testis: 13

PERSON-YEARS OF LIFE LOST IN THE US DUE TO CANCER, ALL RACES, FEMALES: 2006

In 2006, cancer deaths were responsible for more than 8.6 million PYLL. This is more than heart disease or any other cause of death.

Lung cancer accounted for about 2.4 million PYLL, the most by far for any cancer, in part because of the relatively low survival rate and in part because of the relatively early age of onset.

In 2006, for each of the leading cancer sites affecting both men and women, men had more PYLL than women.

The number of person years of life lost due to collective cancer deaths among women, however, was slightly greater than that among men because of the number of person years of life lost due to cancers affecting only women (ex. female breast, ovary).
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