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Indices of Morbidity and Mortality

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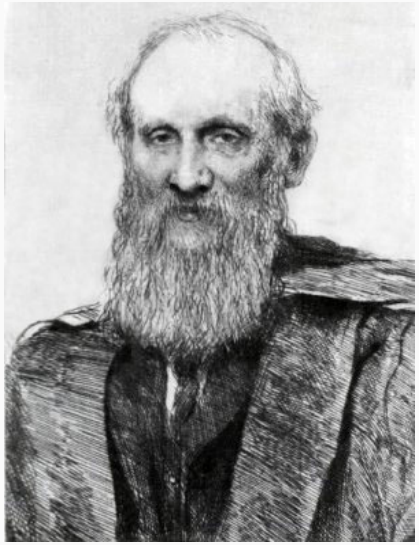
Knowledge of Science



"One's knowledge of science begins when he can measure what he is speaking about and express it in numbers."

— Lord Kelvin (1824–1907)

Source: http://zapatopi.net/lordkelvin.html
Image of Lord Kelvin is in the public domain.

Review of Ratio, Proportion, and Rate

- **Ratio** is one number divided by another number (numerator doesn't have to be included in denominator—and vice versa)
- **Proportion** is a ratio in which the numerator is included in the denominator
  - It has no dimension because the unit of the numerator cancels out the unit of the denominator
- **Rate** is a ratio
  - The numerator is the number of events
    - The unit is event (i.e., number of cases)
  - The denominator is the sum of follow-up time contributed by the people at risk of the event
    - The unit is time or, more accurately, person-time to account for duration of time of follow-up

Quick Check

- What are they—ratio, proportion, or rate? (give reasons)
  - The number of people who ate tuna salad divided by the number of people who did not eat tuna salad
  - The number of people who ate egg salad divided by the number of people who ate tuna salad

Quick Check

- What are they—ratio, proportion, or rate? (give reasons)
  - The number of people who ate tuna salad divided by the number of people who did not eat tuna salad
  - The number of people who ate egg salad divided by the number of people who ate tuna salad
  - The number of sick people who ate tuna salad divided by the number of people who ate tuna salad
  - The number of people diagnosed with influenza on a cruise ship divided by the number of person-weeks of follow-up of people on the cruise ship

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Section A

Incidence and Prevalence

Example of Epidemiologic Language

"In 1997, new cases of TB totaled an estimated 7.96 million, … and there were 16.2 million existing cases of disease. An estimated 1.87 million people died of TB and the global case fatality rate was 23% but exceeded 50% in some African countries with high HIV rates. Global prevalence of Mycobacterium TB infection was 32% (1.86 billion people). Eighty percent of all incident TB cases were found in 22 countries, with more than half the cases occurring in 5 Southeast Asian countries. "

— JAMA (Aug 18, 1999);282(7):677–86

Incidence

- **Incidence** is the number of new cases of a disease occurring in an at-risk population during a defined time interval
  - Example: 80% of all incident TB cases were found in 22 countries

Incidence Proportion

$$\text{Incidence per 1,000} = \frac{\text{Number of NEW cases of a disease occurring in the population during a specified period of time}}{\text{Number of persons at risk of developing the disease during that period of time}} \times 1{,}000$$

Incidence Proportion

- Incidence proportion
  - A measure of risk
  - Example: number of sick people who ate egg salad divided by the total number of people who ate egg salad at a luncheon (time duration is implied)
- Cumulative incidence
  - Example: number of people who have ever had asthma divided by total number of people who were asked the question about ever having asthma
- Attack rate
  - Same as incidence proportion and often used in a disease outbreak
  - It implies rate but is not actually a rate

Incidence Rate

- The numerator is the same as the numerator of incidence proportion
- The denominator accumulates time at risk of the event
  - It is not just the number of people at risk
  - In a study of tuberculosis, an individual who was followed for 5 years will contribute 5 person-years of follow-up to the denominator, while another individual with 3 years of follow-up will contribute 3 years to the denominator
  - Example: incidence rate of tuberculosis = 25 per 10,000 person-years
- Incidence density
  - Same as incidence rate

Incidence Proportion or Incidence Rate

- Sometimes the term **incidence rate** is used even though the measure is a cumulative incidence
- Example: annual incidence rate of lung cancer in U.S. in 2000 was calculated with the number of new lung cancer cases in 2000 as the numerator and the number of people at risk of lung cancer in the U.S. in 2000 as the denominator (and not person-years)
  - In the denominator, it implies that **all** individuals were followed for one year
  - Annual incidence rate of lung cancer = 6 per 10,000 per year

Prevalence

- **Prevalence** is the proportion of population with the disease

$$\text{Prevalence per 1,000} = \frac{\text{Number of cases of disease present in the population at a specified time}}{\text{Number of persons in the population at that specified time}} \times 1{,}000$$

- Example: global prevalence of Mycobacterium TB infection was 32% (1.86 billion people).

About Prevalence

- Prevalence is a proportion
- It measures the extent (amount) of the event (disease) in the population in a specified time
- The numerator includes both new and existing cases of disease
- Time is a descriptor of the measure but is not a part of the denominator (does not use person-time)
- Sometimes, the term **prevalence rate** is used even though it is a proportion
  - Example: prevalence rate of HIV/AIDS in Botswana in 2003 = 37.3%

Source: http://www.nationmaster.com/graph-T/hea_hiv_aid_adu_pre_rat&int=-1

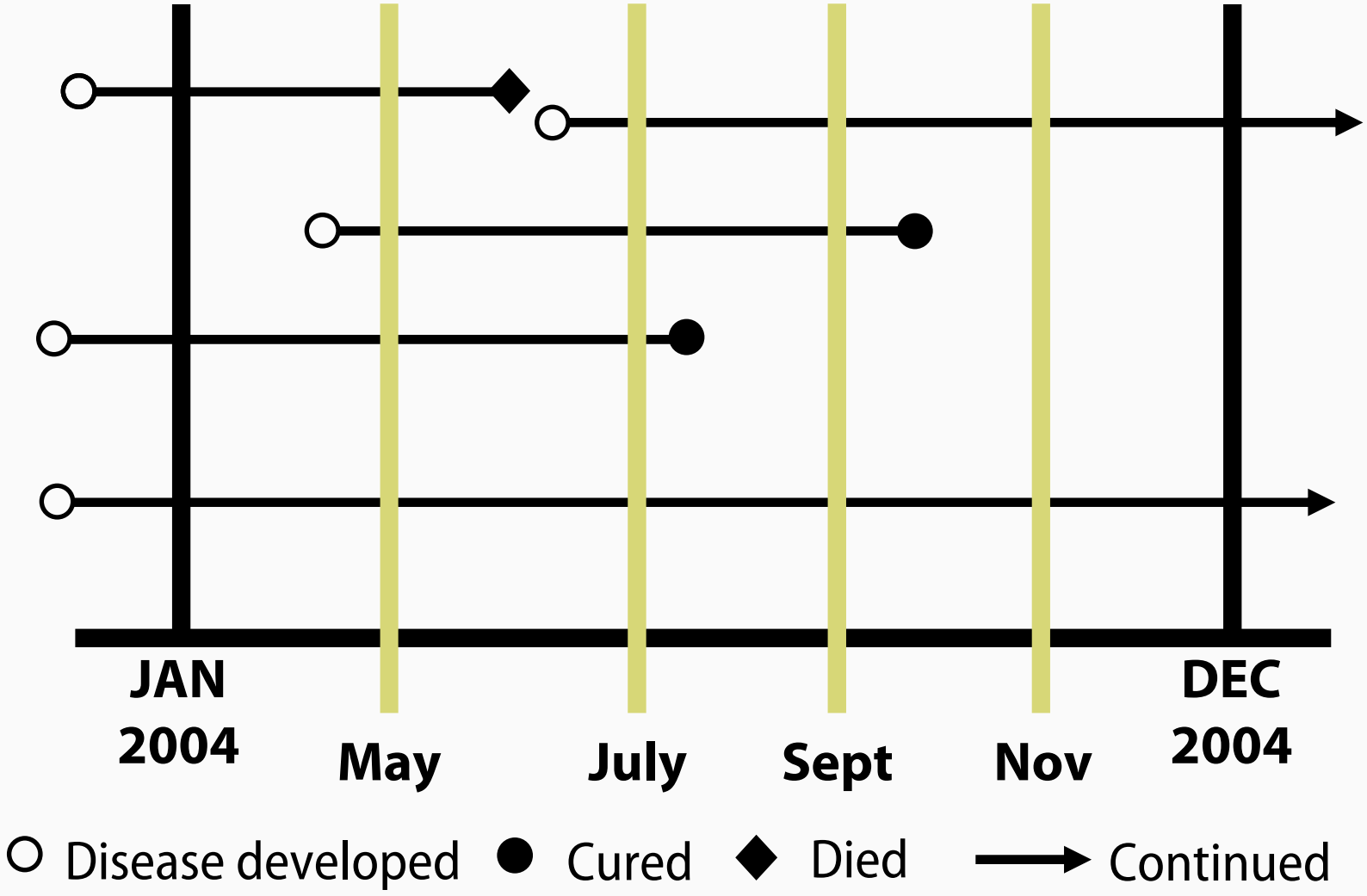
Point and Period Prevalence

- Two types of prevalence
  - **Point prevalence**
  - **Period prevalence**
- Examples of point and period prevalence and cumulative incidence in interview studies of asthma
  - “Do you currently have asthma?”
    - Point prevalence
  - "Have you had asthma during the last n years?”
    - Period prevalence
  - “Have you ever had asthma?”
    - Cumulative or life-time incidence

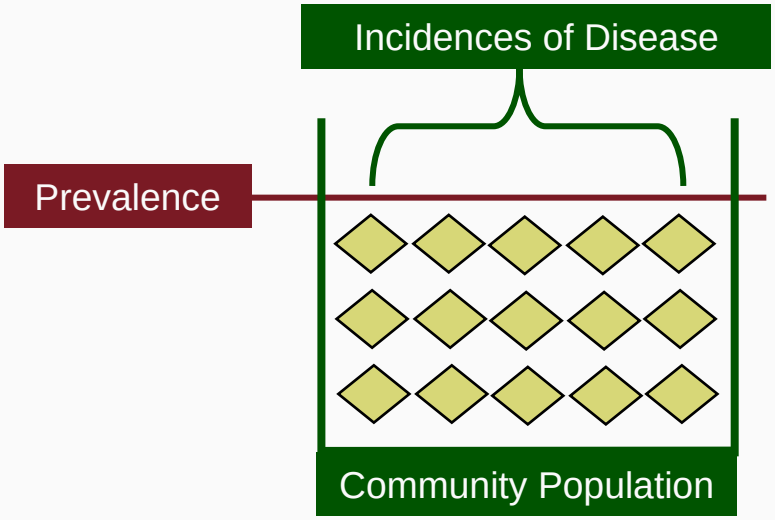
Low Incidence and High Prevalence and Vice Versa

- A chronic, incurable disease, such as diabetes, can have a **low incidence but high prevalence**, because the disease is not very fatal—but it cannot be completely cured either
  - Its prevalence is the sum of new and existing cases from past years
- A short-duration, curable disease, such as the common cold, can have a **high incidence but low prevalence**, because many people get a cold each year—but it lasts for a short time

Counts for Numerators of Incidence and Prevalence



Incidence/Prevalence



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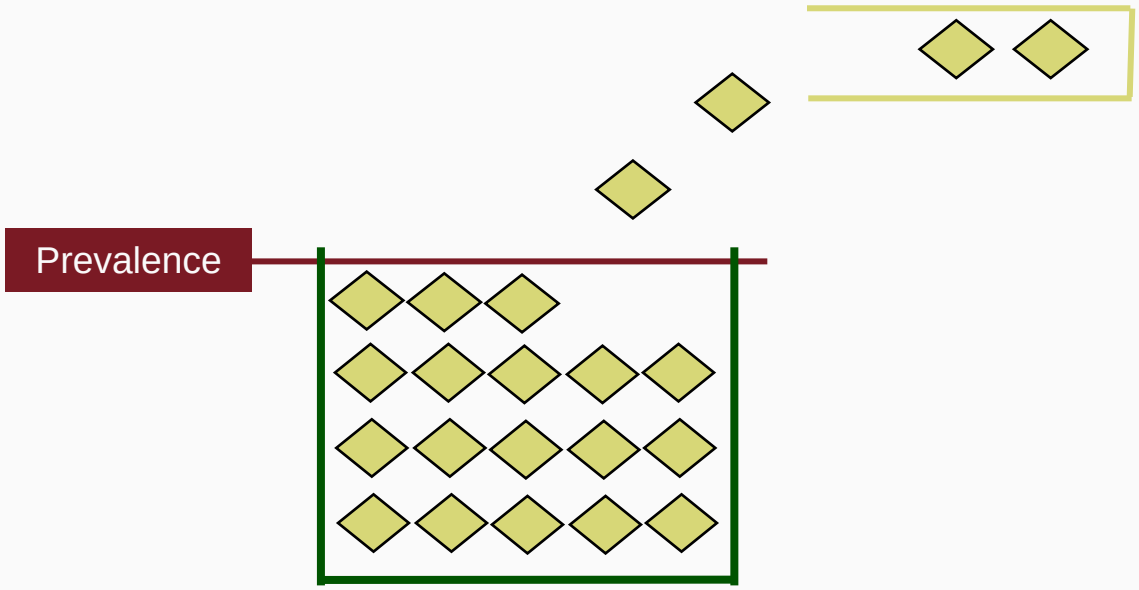
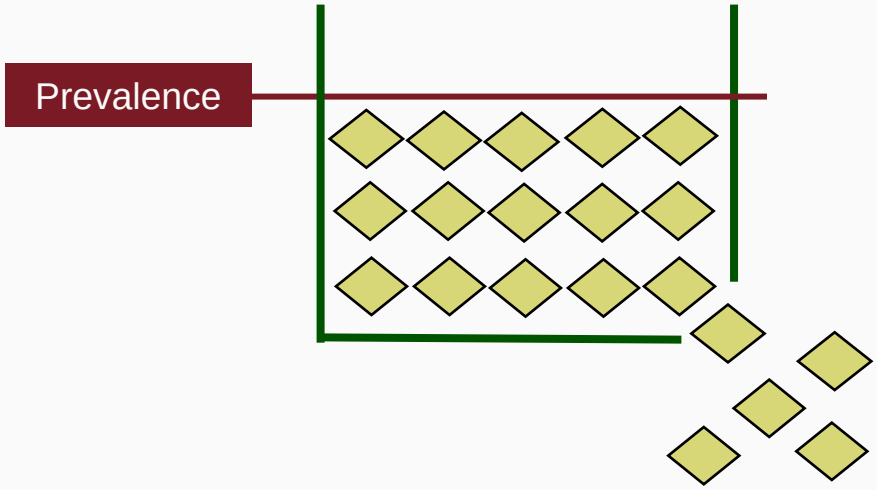


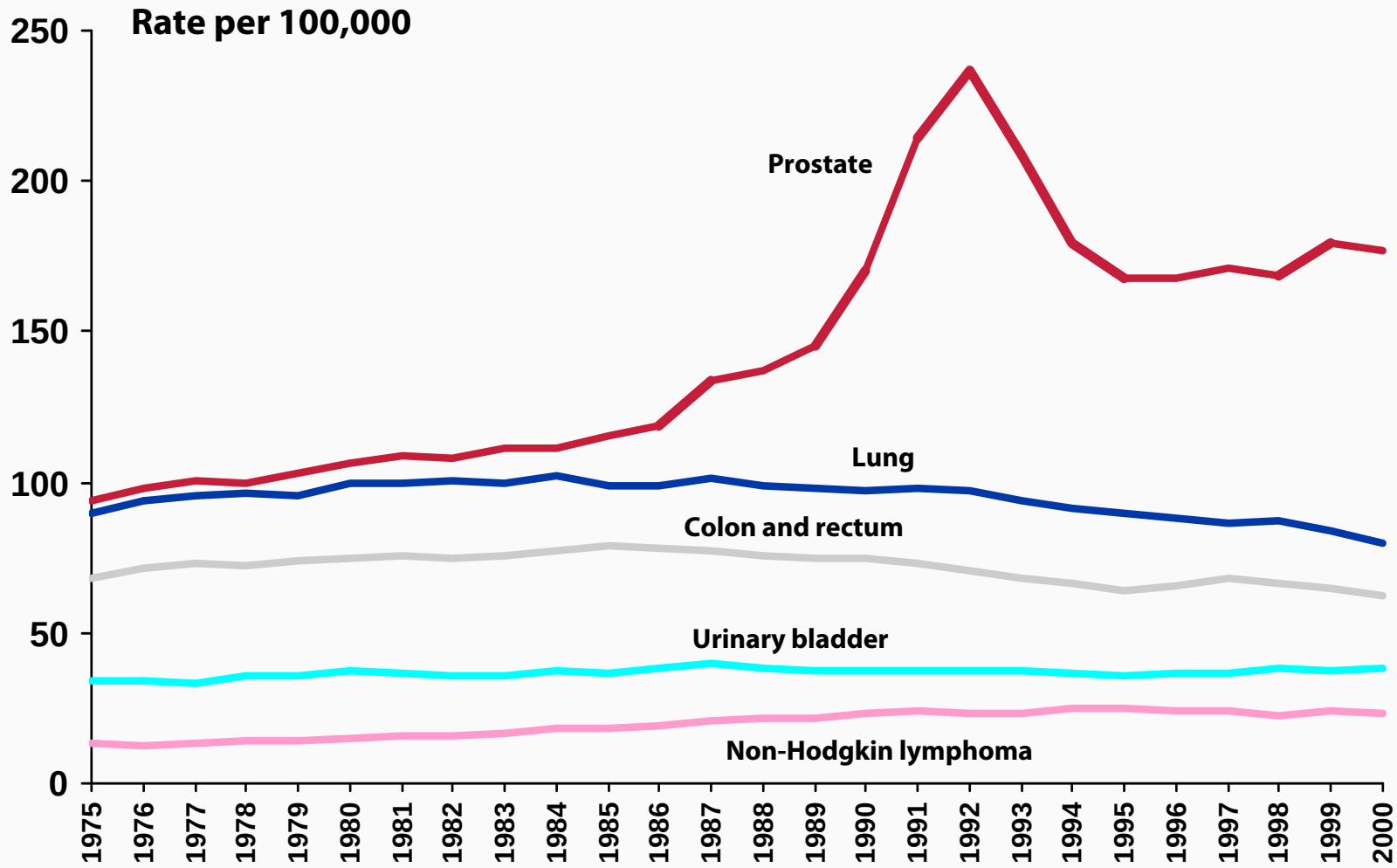
Prevalence increases as new incidences are added to the population

Incidence/Prevalence



Prevalence decreases as incidences are subtracted from the population by death or cure

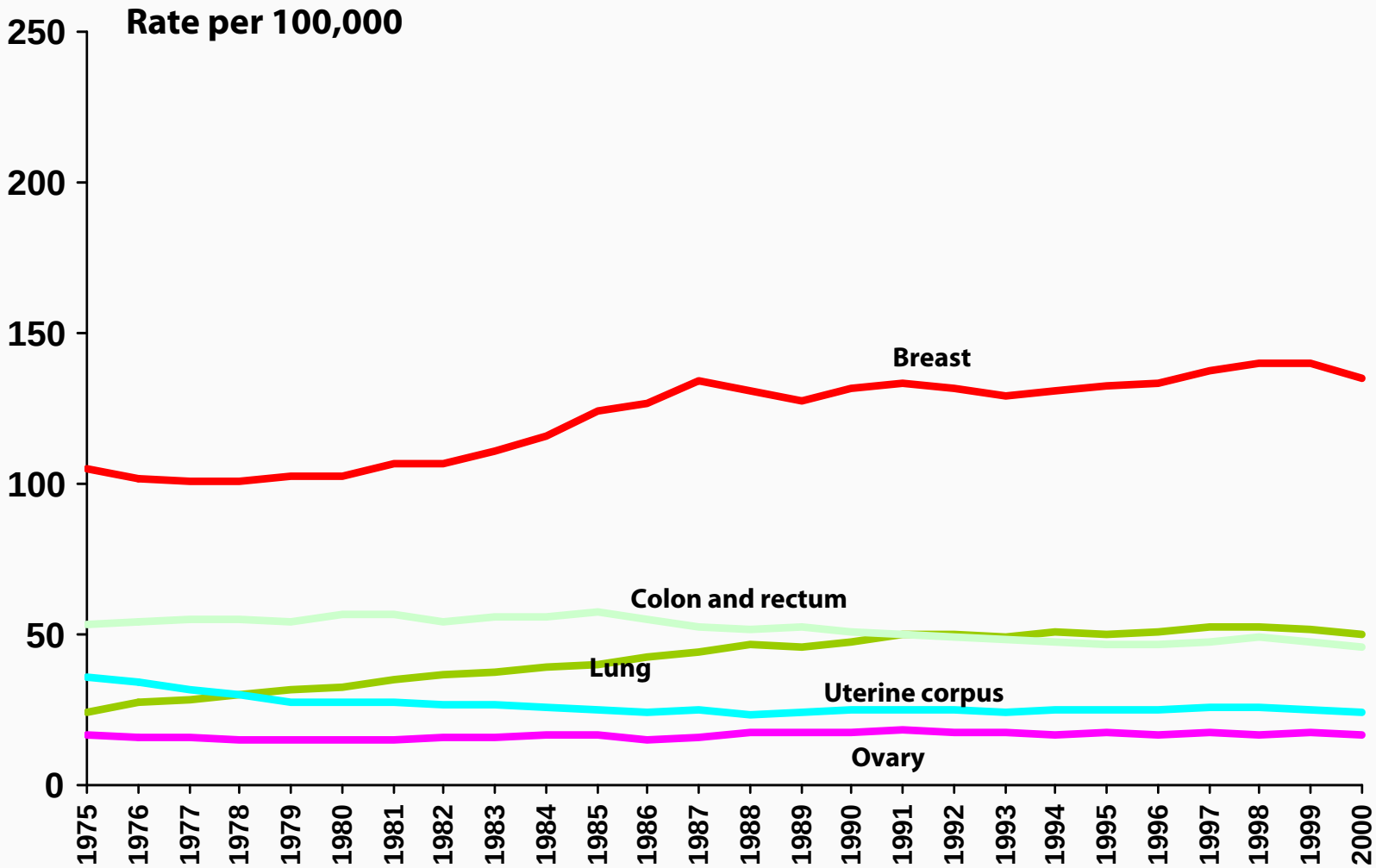
Cancer Incidence Rates for Men, U.S., 1975–2000



Age-adjusted to the 2000 US standard population.

Source: Surveillance, Epidemiology, and End Results Program, 1975–2000, Division of Cancer Control and Population Sciences, National Cancer Institute, 2003.

Cancer Incidence Rates for Women, U.S., 1975–2000



Age-adjusted to the 2000 US standard population.

Source: Surveillance, Epidemiology, and End Results Program, 1975–2000, Division of Cancer Control and Population Sciences, National Cancer Institute, 2003.

Cancer Prevalence

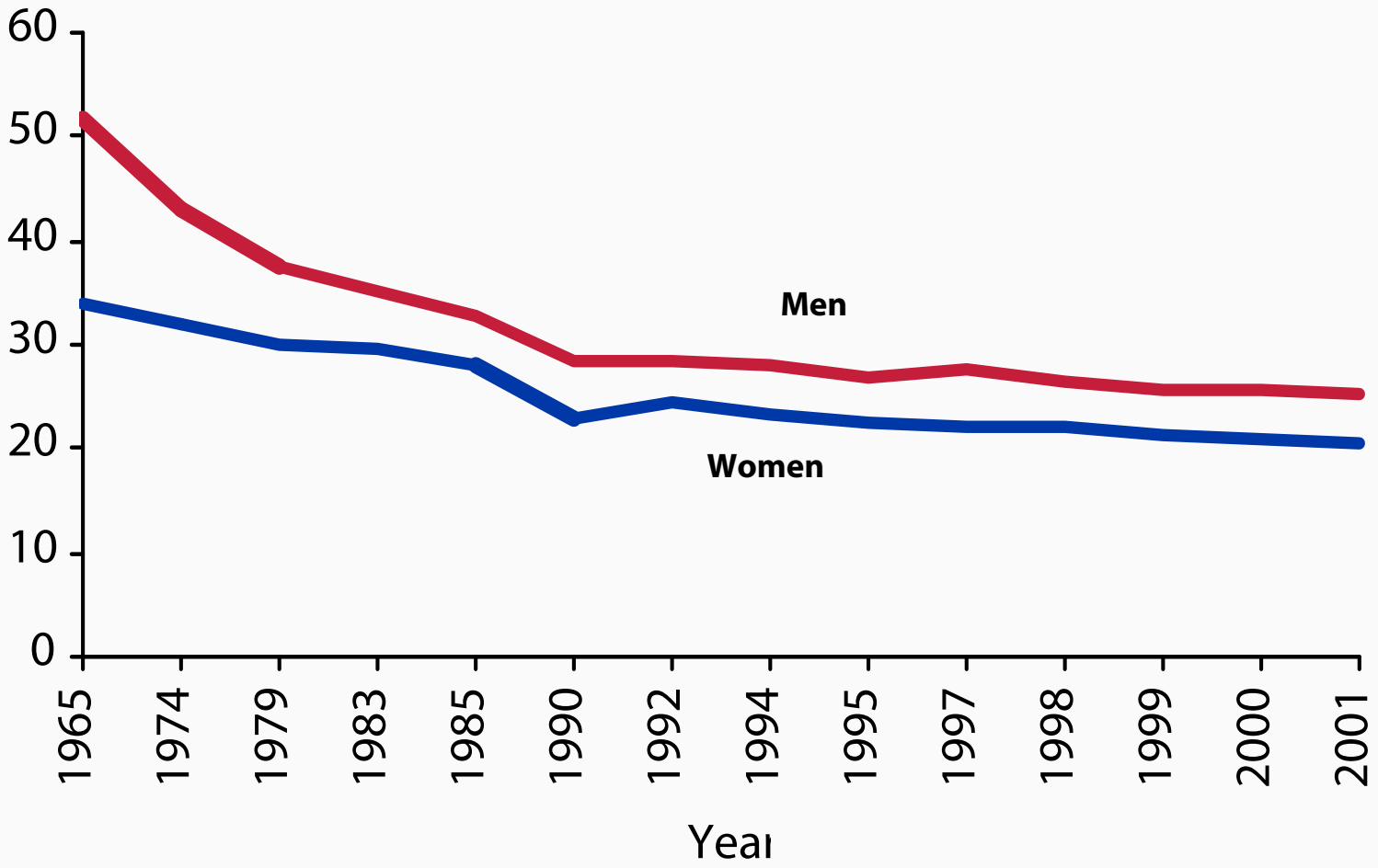
- As of January 1, 1999, it is estimated that there are 8.9 million cancer survivors in the United States
  - This represents approximately 3% of the U.S. population
- Breast, prostate, and colon/rectum cancer are the three most prevalent cancer sites

Source: http://cancercontrol.cancer.gov/ocs/prevalence/index.html

Prevalence of Characteristics

- Prevalence can also refer to the status of a characteristic in the population
- Examples
  - Cigarette smoking prevalence
  - Mammogram prevalence

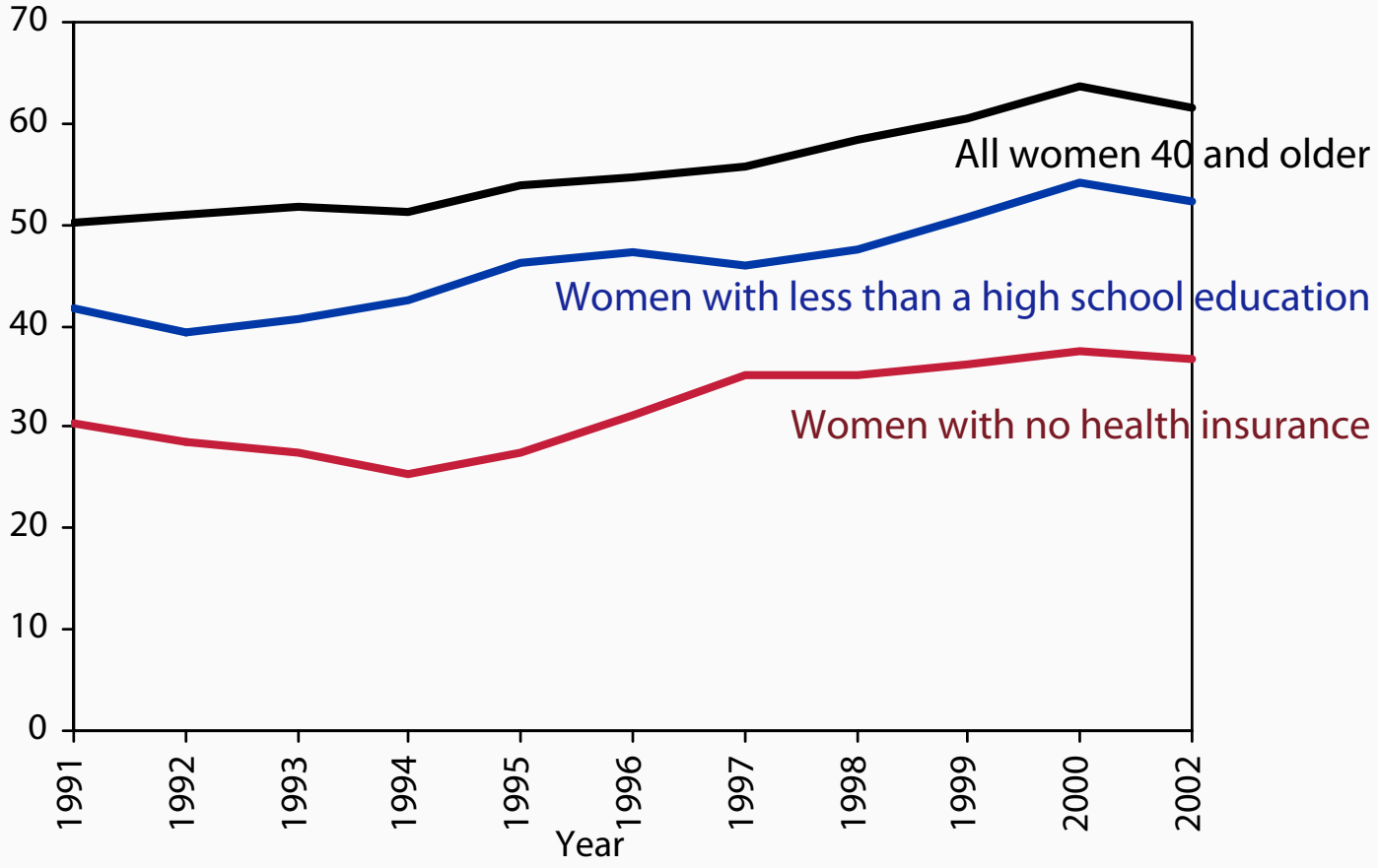
Trends in Cigarette Smoking Prevalence (%) by Gender, Adults 18 and Older, U.S., 1965–2001



Redesign of survey in 1997 may affect trends.

Source: National Health Interview Survey, 1965–2001, National Center for Health Statistics, CDC, 2003.

Mammogram Prevalence (%), Women 40 +, U.S., 1991-2002 by Educational Attainment, Health Insurance Status



Source: Behavior Risk Factor Surveillance System CD-ROM (1984–1995, 1996–1997, 1998, 1999) and Public Use Data Tape (2000, 2002), National Centers for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention 1997, 1999, 2000, 2000, 2001, 2003.

Relation between Incidence and Prevalence

- **Prevalence ~ incidence x duration of disease**
  - Higher incidence results in higher prevalence
  - Longer duration results in higher prevalence

A Hypothetical Example of Chest X-Ray Screening

	Number with Positive X-Ray	Population	Point Prevalence per 1,000
High SES	100	1,000	**100**
Low SES	60	1,000	**60**

A Hypothetical Example of Chest X-Ray Screening

	Point Prevalance per 1,000	Incidence	Average Duration
High SES	100	4/year	25 years
Low SES	60	20/year	3 years

Review Questions

- What is the difference between **incidence** and **prevalence?**
- How are they related?

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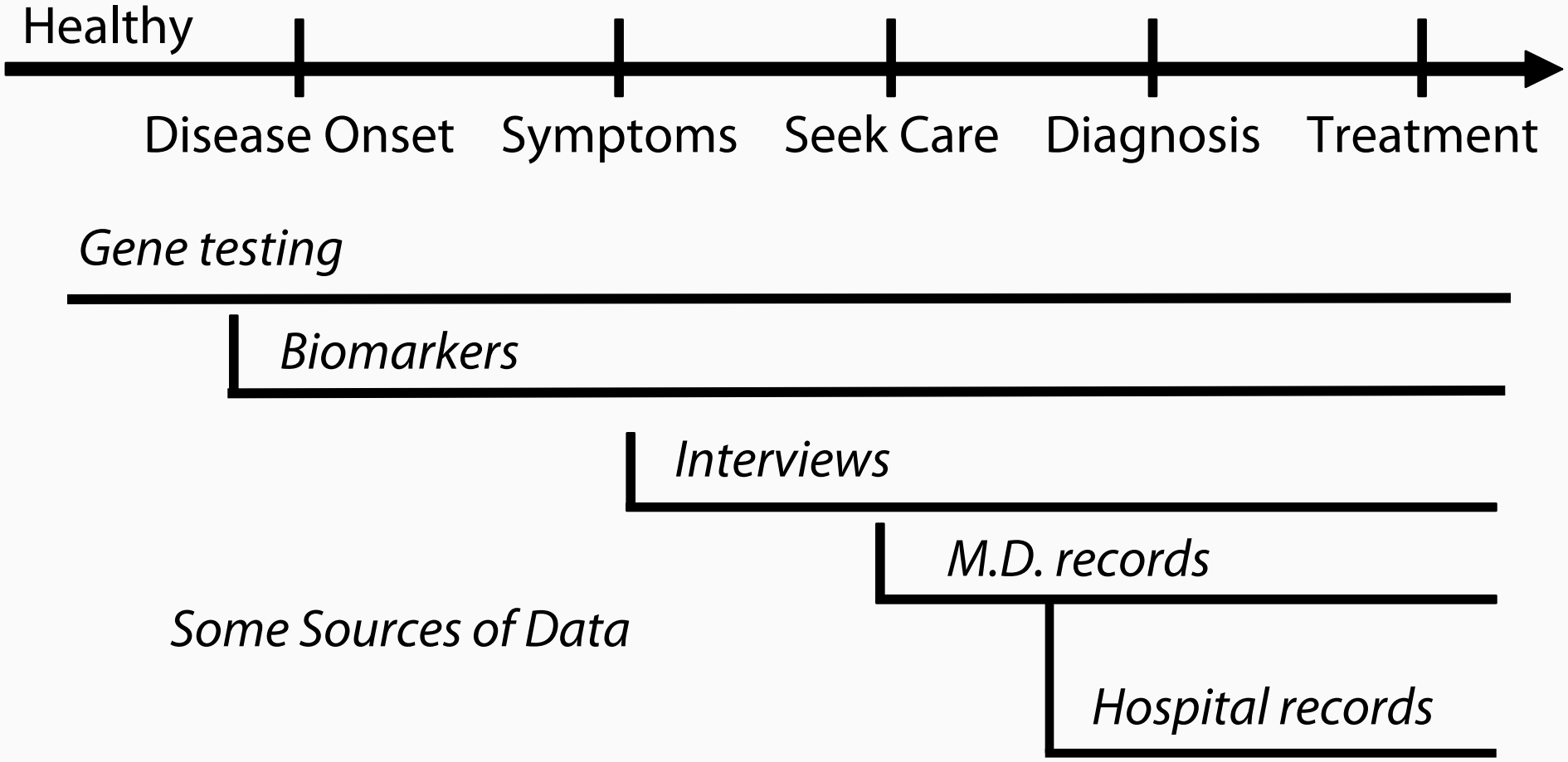
Section B

Sources of Morbidity Data

The Natural History of Disease and Sources of Data



Examples of Sources of Morbidity Statistics

- Hospitals and clinics
- Disease/cancer registries
- Surveillance systems, such as communicable disease reporting

Examples of Sources of Morbidity Statistics

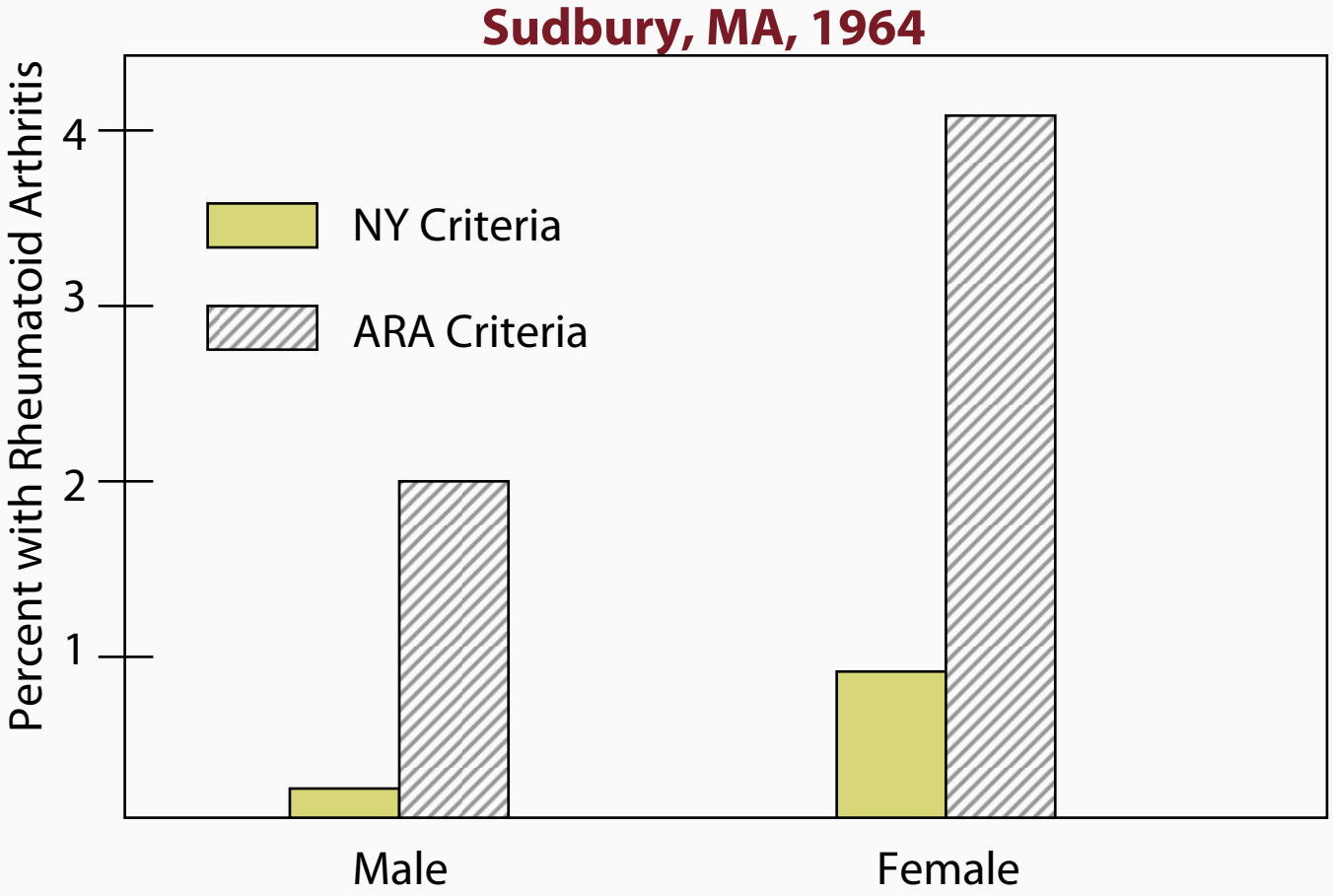
- Hospitals and clinics
- Disease/cancer registries
- Surveillance systems, such as communicable disease reporting
- Surveys, such as NHANES, NHCS, NHIS
- Insurance and prepaid medical plans
- Tax-financed medical plans
- Industry
- Records of military personnel

Problems with Incidence and Prevalence Measurements

- Problems with numerators
  - Definition
  - Data collection methods
  - Sources
- Problems with denominators
  - Definition
  - Appropriateness

Different Definitions of Rheumatoid Arthritis

- The percent of the population with a diagnosis of rheumatoid arthritis—New York criteria vs. American Rheumatism Association criteria



Source: O'Sullivan & Cathcart, *Ann Intern Med,* 76:573, 1972.

Problems with Numerators

- Different definitions and lack of uniform criteria for reporting
  - Not until 1990 was there a uniform criteria for reporting cases to CDC
    - "Case Definitions for Public Health Surveillance" document
- Different uses of confirmatory lab tests or epidemiologic criteria
  - Example: the inclusion of exposure to a point source of infection in the definition
- Use of International Classification of Diseases, Clinical Modification (ICD-9-CM) to code morbidity data may underestimate disease incidence due to its use for insurance billing purpose

Problems with Numerators

- Different methods are used to gather data (questionnaires, telephone interview, direct examinations, hospital record abstraction, etc.)
- Hospital records are incomplete, illegible, and not intended for use in research

Different Sources of Data

Comparison of Patients' Statements with Examination Findings Concerning Circumcision, Roswell Park Medical Institute, Buffalo, N.Y.

	Patients' Statements					
	Circumcised		Not circumcised		Total	
Examination finding	No.	%	No.	%	No.	%
Circumcised	37		47		84	43.8
Not circumcised	19		89		108	56.2
Total	56	29.2	136	70.8	192	100.0

Self-reported status was correct in 37/56=66% and 89/136=65%

Source: Lilienfeld et al, 1958

Different Sources of Data

Comparison of Patients' Statements with Examination Findings Concerning Circumcision, HPV Studies, Several Countries, 2002						
	Patients' Statements					
	Circumcised		Not circumcised		Total	
Examination finding	No.	%	No.	%	No.	%
Circumcised	282		37		319	40.4
Not circumcised	5		466		471	59.6
Total	287	36.3	503	63.7	790	100.0

Self-reported status was correct in 282/287=98% and 466/503=93%

Source: NEJM 346:1105-1112, 2002

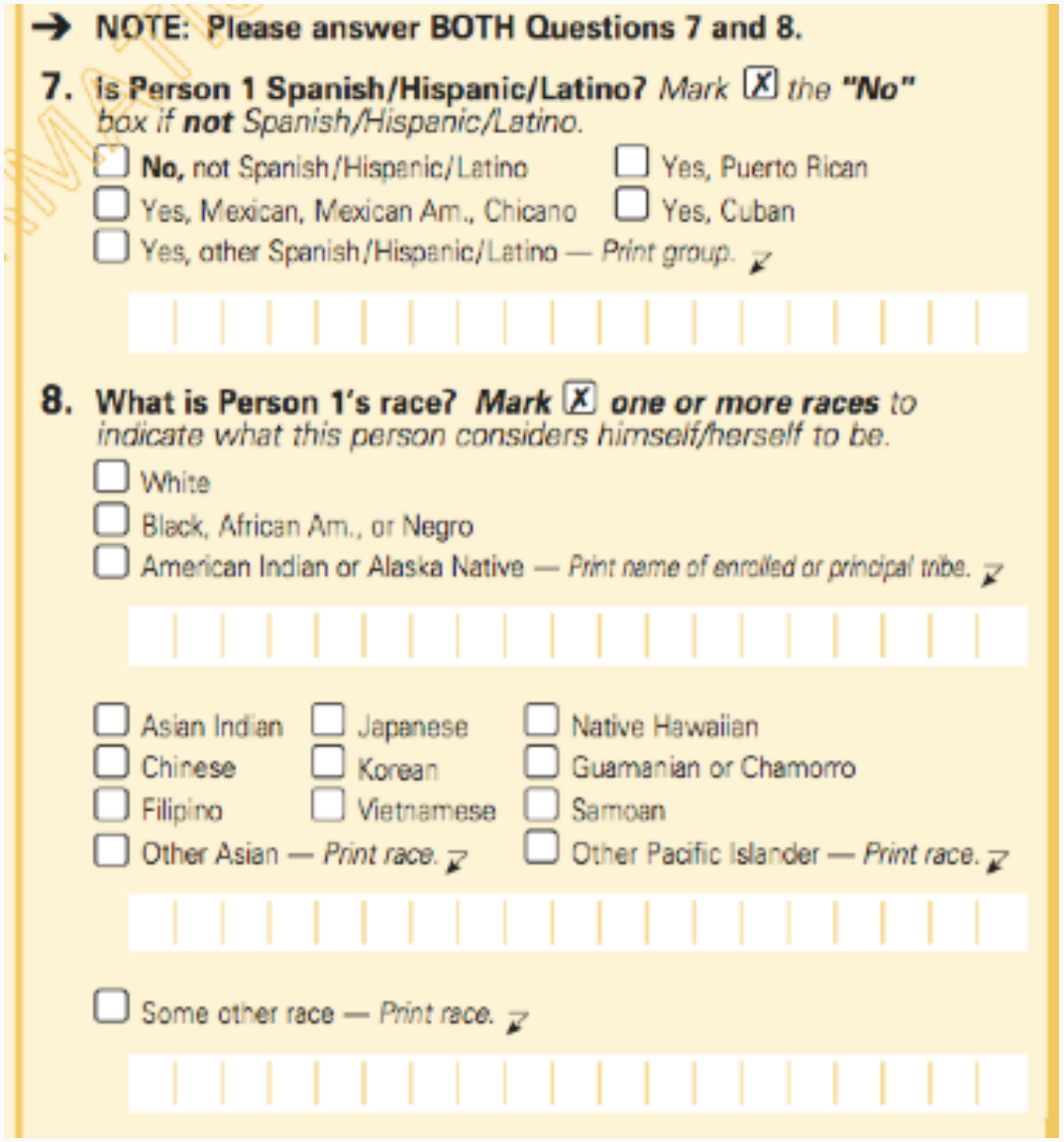
Problems with Denominators

- Variable geographic boundary of population at risk
  - Hospital referral area
- Selection of appropriate denominators for study question
  - Example: study of accident and cell phone use while operating a motor vehicle
  - Denominator = ?
    - Number of cars, number of drivers, number of trips, number of miles, number of minutes
- Definition of characteristics, such as ethnicity
- Inclusion of people who are not at risk in the denominator

Census Definition/Data

Estimated Spanish Ancestry Population in New Mexico, Based on a 1970 U.S. Census (According to Which Census Definition Is Used)	
Definition Used	*Estimated Population*
Birth and parentage	40,173
Spanish language	379,723
Spanish surname	324,248
Spanish origin	308,340
Spanish heritage	407,286

From the Short Form of the U.S. 2000 Census



→ **NOTE: Please answer BOTH Questions 7 and 8.**

7. **Is Person 1 Spanish/Hispanic/Latino?** *Mark* ☒ *the* ***"No"*** *box if* ***not*** *Spanish/Hispanic/Latino.*

- ☐ **No,** not Spanish/Hispanic/Latino
- ☐ Yes, Puerto Rican
- ☐ Yes, Mexican, Mexican Am., Chicano
- ☐ Yes, Cuban
- ☐ Yes, other Spanish/Hispanic/Latino — *Print group.*

8. **What is Person 1's race?** ***Mark*** ☒ ***one or more races*** *to indicate what this person considers himself/herself to be.*

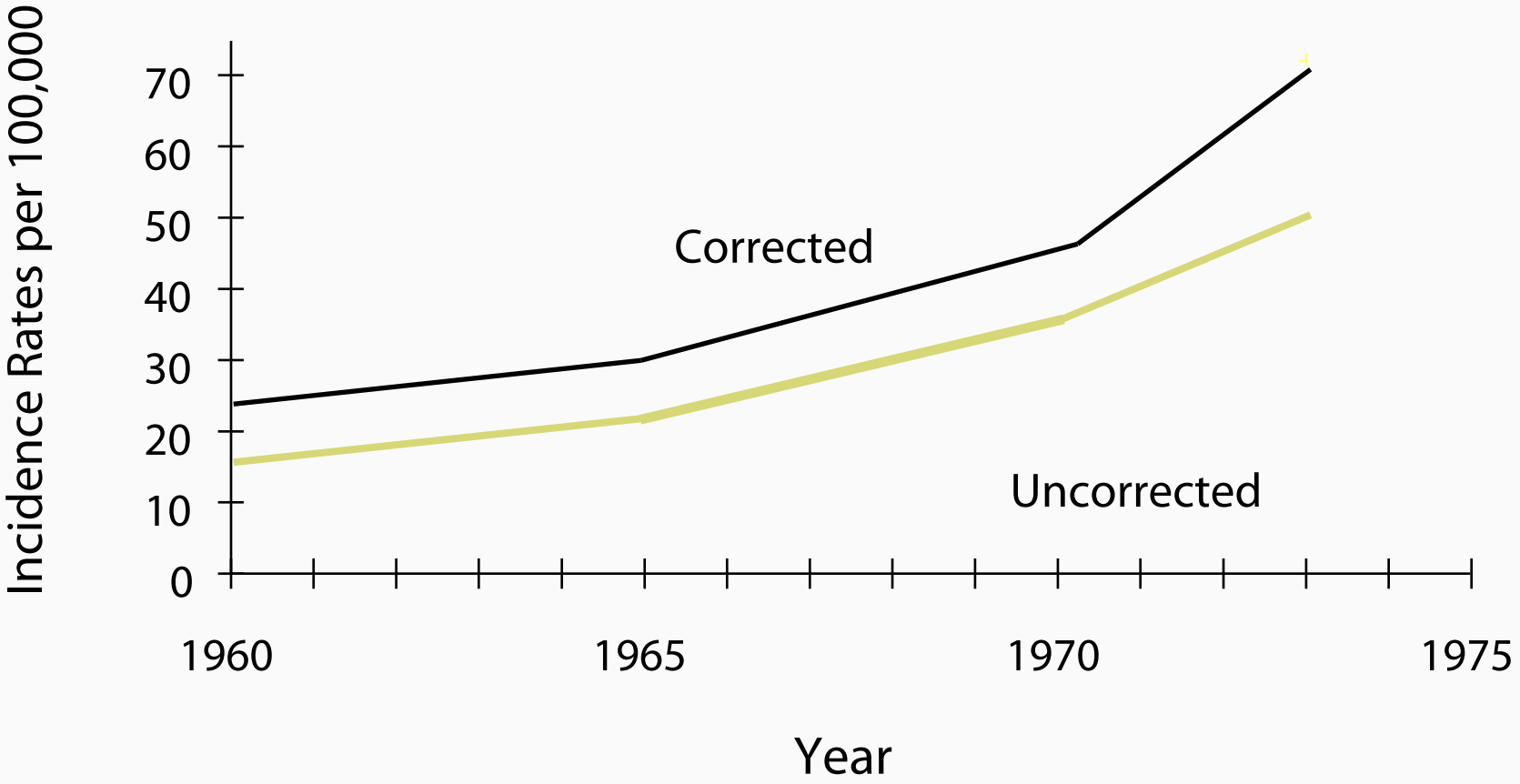
- ☐ White
- ☐ Black, African Am., or Negro
- ☐ American Indian or Alaska Native — *Print name of enrolled or principal tribe.*

- ☐ Asian Indian
- ☐ Japanese
- ☐ Native Hawaiian
- ☐ Chinese
- ☐ Korean
- ☐ Guamanian or Chamorro
- ☐ Filipino
- ☐ Vietnamese
- ☐ Samoan
- ☐ Other Asian — *Print race.*
- ☐ Other Pacific Islander — *Print race.*

- ☐ Some other race — *Print race.*

Inclusion of Population at Risk in the Denominator

- Age-adjusted uterine cancer incidence rates, Alameda County
  - Corrected and uncorrected—by hysterectomy status



Hysterectomy = removal of uterus

Source: Lyon and Gardner

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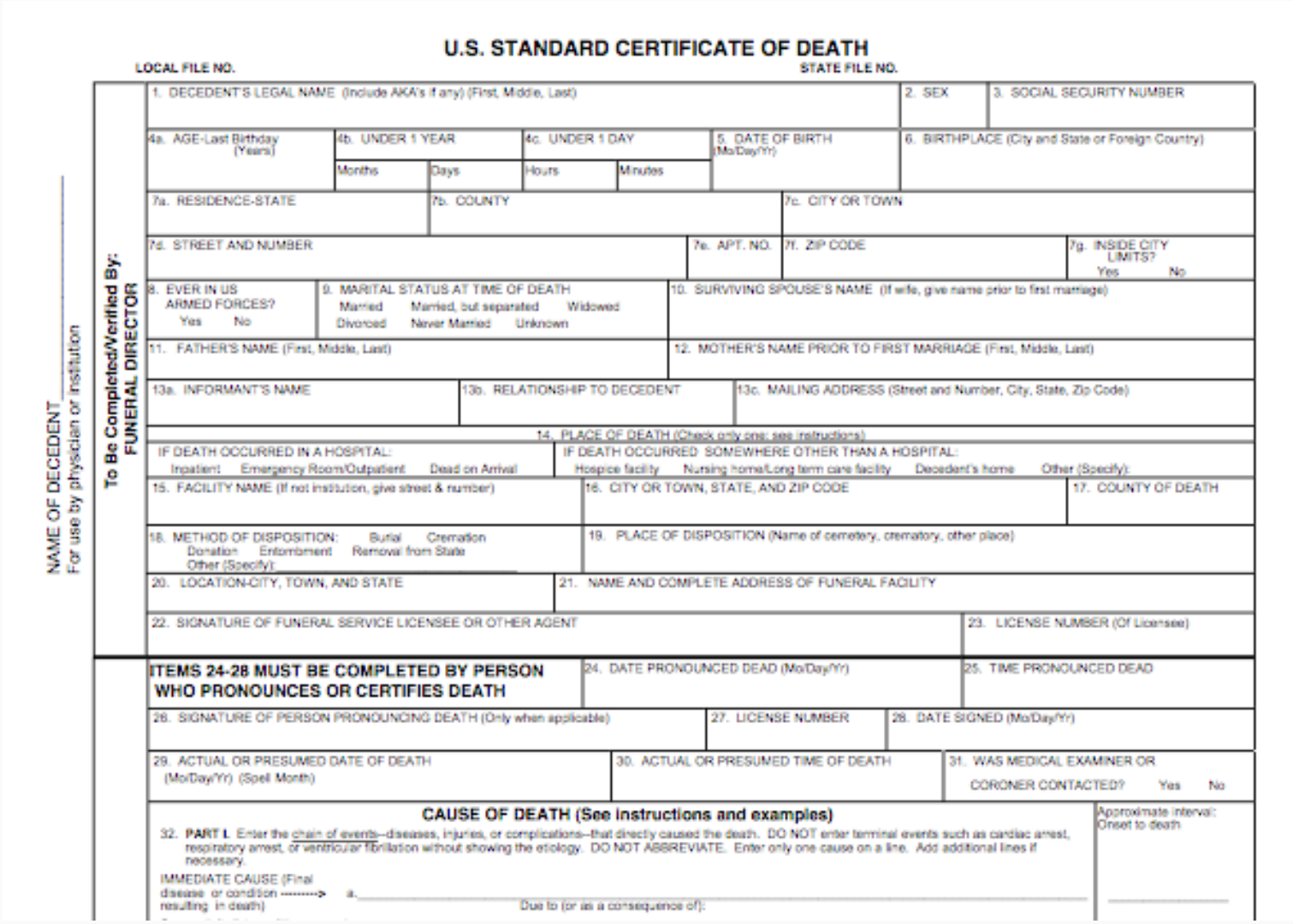
Section C

Indices of Mortality

About Mortality

- Death is the foundation of all vital statistics
- The early work on vital statistics was done by John Graunt (1620–1674), a British demographer
  - His work on the Bills of Mortality led to development of statistical methods to analyze mortality data
- In most countries, laws require registration of deaths
- In the U.S., physicians, coroners, or medical examiners must certify all deaths and provide diagnosis for causes of death
  - All deaths are recorded and reported to local and state health departments—and finally to the National Center for Health Statistics (NCHS)
  - NCHS developed a **Standard Certificate of Death** to be used by all states
    - It followed the format recommended by WHO

Example of a Death Certificate



U.S. STANDARD CERTIFICATE OF DEATH

LOCAL FILE NO. STATE FILE NO.

NAME OF DECEDENT
For use by physician or institution

To Be Completed/Verified By: FUNERAL DIRECTOR

1. DECEDENT'S LEGAL NAME (Include AKA's if any) (First, Middle, Last) | 2. SEX | 3. SOCIAL SECURITY NUMBER

4a. AGE-Last Birthday (Years) | 4b. UNDER 1 YEAR: Months, Days | 4c. UNDER 1 DAY: Hours, Minutes | 5. DATE OF BIRTH (Mo/Day/Yr) | 6. BIRTHPLACE (City and State or Foreign Country)

7a. RESIDENCE-STATE | 7b. COUNTY | 7c. CITY OR TOWN

7d. STREET AND NUMBER | 7e. APT. NO. | 7f. ZIP CODE | 7g. INSIDE CITY LIMITS? Yes No

8. EVER IN US ARMED FORCES? Yes No | 9. MARITAL STATUS AT TIME OF DEATH: Married, Married, but separated, Widowed, Divorced, Never Married, Unknown | 10. SURVIVING SPOUSE'S NAME (If wife, give name prior to first marriage)

11. FATHER'S NAME (First, Middle, Last) | 12. MOTHER'S NAME PRIOR TO FIRST MARRIAGE (First, Middle, Last)

13a. INFORMANT'S NAME | 13b. RELATIONSHIP TO DECEDENT | 13c. MAILING ADDRESS (Street and Number, City, State, Zip Code)

14. PLACE OF DEATH (Check only one; see instructions)

IF DEATH OCCURRED IN A HOSPITAL: Inpatient, Emergency Room/Outpatient, Dead on Arrival

IF DEATH OCCURRED SOMEWHERE OTHER THAN A HOSPITAL: Hospice facility, Nursing home/Long term care facility, Decedent's home, Other (Specify):

15. FACILITY NAME (If not institution, give street & number) | 16. CITY OR TOWN, STATE, AND ZIP CODE | 17. COUNTY OF DEATH

18. METHOD OF DISPOSITION: Burial, Cremation, Donation, Entombment, Removal from State, Other (Specify): | 19. PLACE OF DISPOSITION (Name of cemetery, crematory, other place)

20. LOCATION-CITY, TOWN, AND STATE | 21. NAME AND COMPLETE ADDRESS OF FUNERAL FACILITY

22. SIGNATURE OF FUNERAL SERVICE LICENSEE OR OTHER AGENT | 23. LICENSE NUMBER (Of Licensee)

ITEMS 24-28 MUST BE COMPLETED BY PERSON WHO PRONOUNCES OR CERTIFIES DEATH

24. DATE PRONOUNCED DEAD (Mo/Day/Yr) | 25. TIME PRONOUNCED DEAD

26. SIGNATURE OF PERSON PRONOUNCING DEATH (Only when applicable) | 27. LICENSE NUMBER | 28. DATE SIGNED (Mo/Day/Yr)

29. ACTUAL OR PRESUMED DATE OF DEATH (Mo/Day/Yr) (Spell Month) | 30. ACTUAL OR PRESUMED TIME OF DEATH | 31. WAS MEDICAL EXAMINER OR CORONER CONTACTED? Yes No

CAUSE OF DEATH (See instructions and examples)

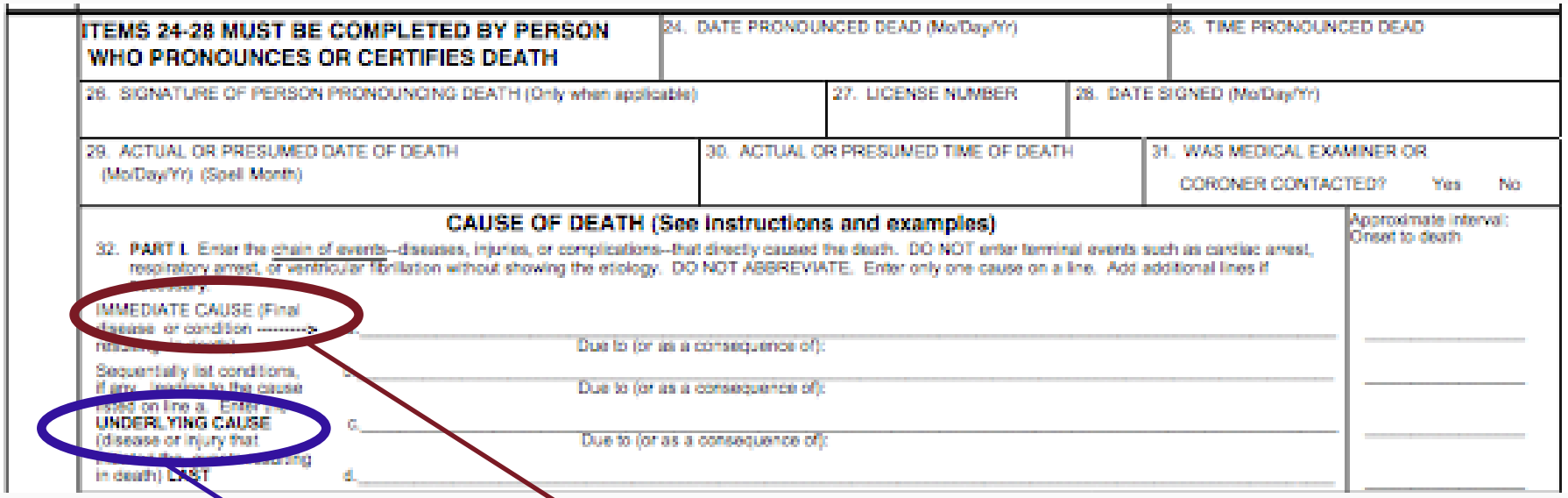
32. **PART I.** Enter the chain of events--diseases, injuries, or complications--that directly caused the death. DO NOT enter terminal events such as cardiac arrest, respiratory arrest, or ventricular fibrillation without showing the etiology. DO NOT ABBREVIATE. Enter only one cause on a line. Add additional lines if necessary.

IMMEDIATE CAUSE (Final disease or condition ---------> resulting in death) a. _____

Due to (or as a consequence of):

Approximate interval: Onset to death

Section on Causes of Death



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CAUSE OF DEATH (See instructions and examples)

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Approximate interval: Onset to death

IMMEDIATE CAUSE (Final disease or condition ----------> a. _____ Due to (or as a consequence of):

Sequentially list conditions, if any, leading to the cause given on line a. Enter the UNDERLYING CAUSE (disease or injury that initiated the events resulting in death) LAST

b. _____ Due to (or as a consequence of):

c. _____ Due to (or as a consequence of):

d. _____

Immediate cause of death

Underlying cause of death

Causes of Death on Death Certificate

- The immediate cause of death and the underlying cause of death are found on a death certificate
  - The underlying cause of death is the disease or injury that initiated the set of events leading to death
- Causes of death are coded according to the rules set forth in the International Classification of Diseases (ICD)
  - ICD-9 first used in 1979
  - ICD-10 first used in 1999
- Rules for selection of the underlying cause of death can be found in ICD
- Nosologists, MICAR (Mortality Medical Indexing, Classification, and Retrieval), SuperMICAR, ACME (Automated Classification of Medical Entities)

Example: Coding of an Underlying Cause of Death

- Death was caused by

Immediate cause	A) Cerebral hemorrhage
Due to	B) Nephritis
Due to	C) Cirrhosis of liver

- Cirrhosis of liver is the underlying cause of death
  - It is coded as *571.5*

Source: Israel and Klebra, 1964

The 10 Leading Causes of Death in 1996: ICD-9 and -10

ICD-9	ICD-10
1. Heart diseases	1. Heart diseases
2. Malignant neoplasms	2. Malignant neoplasms
3. Cerebrovascular diseases	3. Cerebrovascular diseases
4. COPD	4. Chronic lower respiratory diseases
5. Accidents	5. Accidents
6. Pneumonia and influenza	6. Diabetes
7. Diabetes	7. Influenza and pneumonia
8. HIV	8. Alzheimer's disease
9. Suicide	9. HIV
10. Chronic liver disease and cirrhosis	10. Intentional self-harm (suicide)

Sources of Mortality Statistics

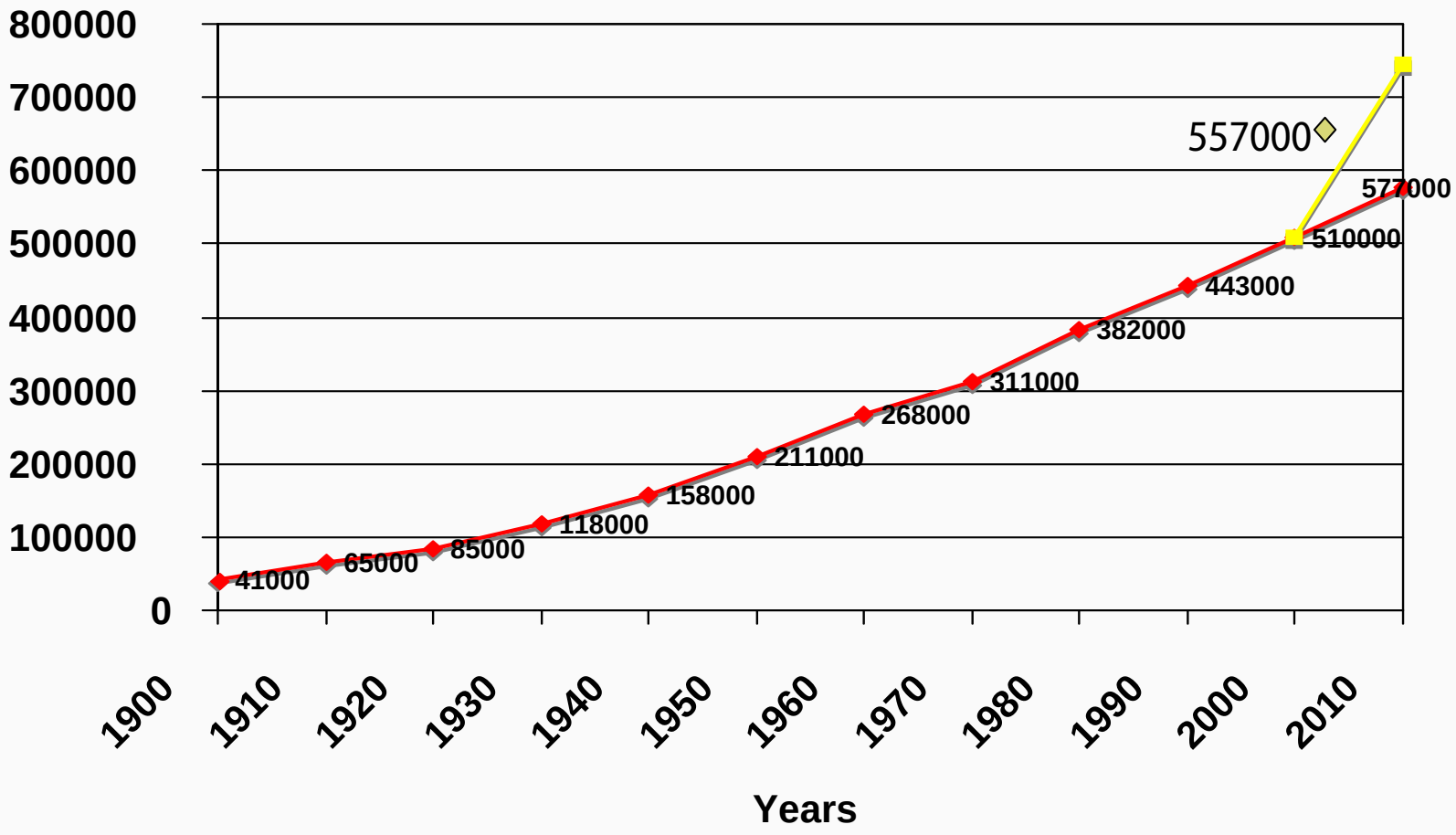
- National Center for Health Statistics
  - National Death Index (NDI)
- Centers for Disease Control and Prevention (CDC)
  - *Morbidity and Mortality Weekly Report*
- State vital records
- Tumor registries

Quick Check

- How many deaths occurred in the United States last year?
  - **A.** 25,000
  - **B.** 250,000
  - **C.** 2,500,000
  - **D.** 25,000,000
- How many deaths occurred in your state (or country, if not U.S.) last year?
- Heart diseases are the leading cause of death in the United States
  - What is the leading cause of death in your state (or your country)?

http://www.cdc.gov/nchs/data/nvsr/nvsr53/nvsr53_15.pdf

Forecast of Cancer Deaths



Mortality Rate

$$\text{Annual mortality rate from all causes (per 1,000 population)} = \frac{\text{Total number of deaths from all causes in one year}}{\text{Number of persons in the population at midyear}} \times 1{,}000$$

Calculation of Mortality Rate

- It is usually calculated on an annual basis
- Numerator is the number of deaths
- For vital statistics purpose, the midpoint (midyear) population is used with the assumption that:
  - Addition and subtraction of population occur uniformly throughout the year
  - If the actual person-years of follow-up were calculated for all individuals in a year, the value will be equivalent to the number of population at midyear times one
    - That is, followed for one full year
- The denominator thus becomes person-year, and mortality rate can be considered as a "rate" and not a "proportion"
  - Even though the number of persons at midyear is used in the calculation

Example: Mortality Rate

$$\text{Annual mortality rate from all causes (per 1,000 population)} = \frac{\text{20 deaths from all causes in one year}}{\text{12,000 persons in the population at midyear}} \times 1{,}000$$

$$= \text{1.7 per 1,000}$$

Age-Specific Mortality Rate

$$\text{Annual mortality rate from all causes for children under age 10 (per 1,000 population)} = \frac{\text{Total number of deaths from all causes in one year in children under age 10}}{\text{Number of children in the population under age 10 at midyear}} \times 1{,}000$$

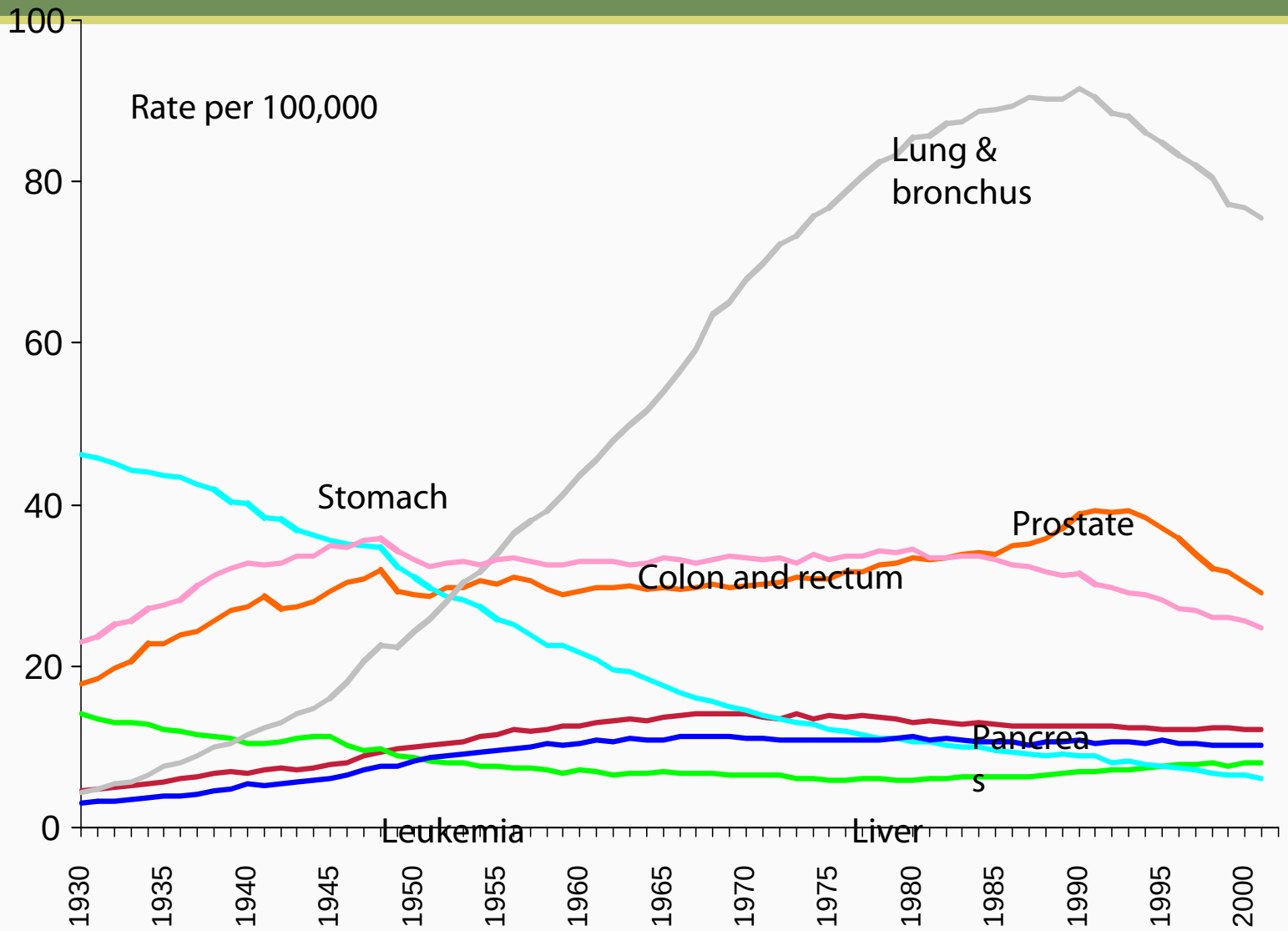
Cause-Specific Mortality Rate

$$\text{Annual mortality rate from lung cancer (per 1,000 population)} = \frac{\text{Total number of deaths from lung cancer in one year}}{\text{Number of persons in the population at midyear}} \times 1{,}000$$

Age- and Cause-Specific Mortality Rate

$$\text{Annual mortality rate from leukemia for children under age 10 (per 1,000 population)} = \frac{\text{Total number of deaths from leukemia in one year in children under age 10}}{\text{Number of children in the population under age 10 at midyear}} \times 1{,}000$$

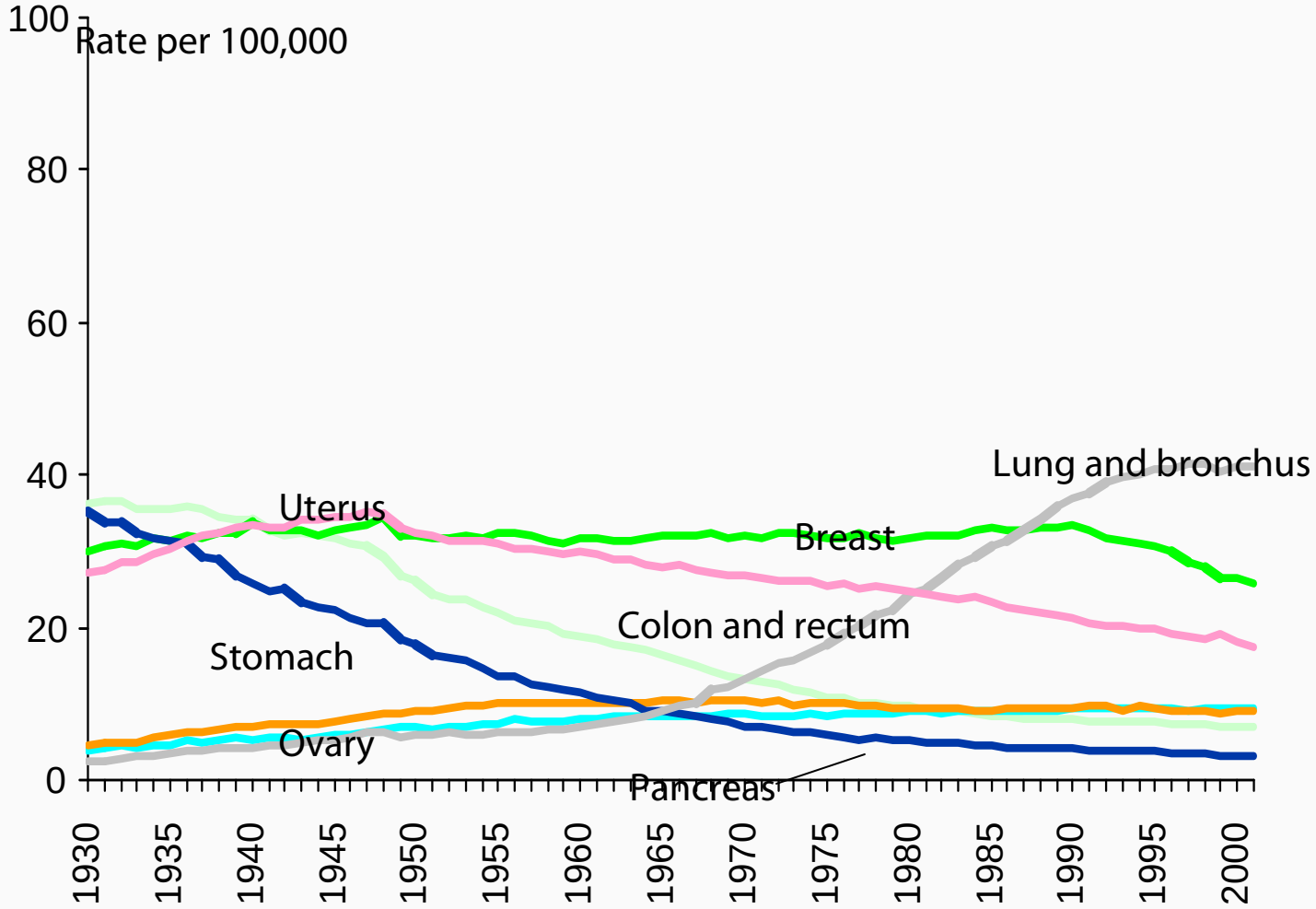
Cancer Death Rates, for Men, U.S.,1930–2001*



*Age-adjusted to the 2000 U.S. standard population.

Source: U.S. Mortality Public Use Data Tapes 1960–2001, US Mortality Volumes 1930–1959, NCHS, CDC, 2004.

Cancer Death Rates, for Women, U.S.,1930–2001*



*Age-adjusted to the 2000 U.S. standard population.

Source: U.S. Mortality Public Use Data Tapes 1960–2001, US Mortality Volumes 1930–1959, NCHS, CDC, 2004.

Case Fatality Rate

$$\textbf{Case fatality rate (\%)} = \frac{\text{Number of individuals dying during a specified period of time after disease onset or diagnosis}}{\text{Number of individuals with the specified disease}} \times 100$$

Comparison of Mortality Rate and Case Fatality Rate

- Assume a population of 100,000 people
  - 20 are sick with disease "X"
  - In one year, 18 die from disease "X"
- The mortality rate in that year from disease "X"

$$= \frac{18}{100{,}000}$$

$$= 0.00018 \text{ (or } 0.018\%)$$

- Case fatality rate from "X" $= \frac{18}{20}$

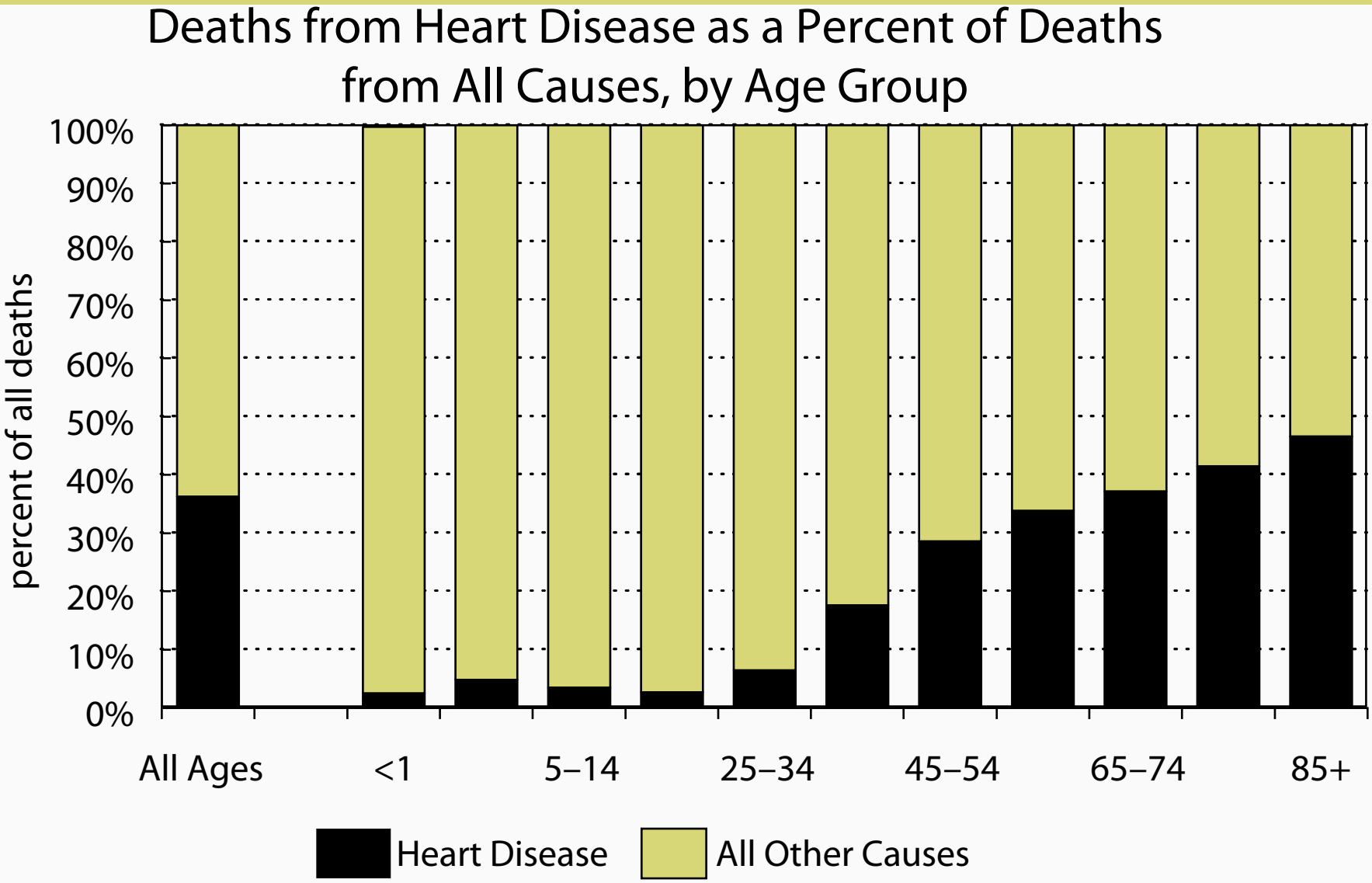
$$= 0.9 \text{ or } 90\%$$

Proportionate Mortality

Proportionate mortality from cardiovascular diseases in the U.S. in 2000

$$= \frac{\text{Number of deaths from cardiovascular diseases in the U.S. in 2000}}{\text{Total deaths in the U.S. in 2000}}$$

Example of Proportionate Mortality



Comparison: Mortality Rate and Proportionate Mortality

- Deaths from heart disease in two communities, "A" and "B"

	A	B
Mortality rate from all causes	30/1,000	15/1,000
Proportionate mortality from heart disease	10%	20%
Mortality rate from heart disease		

Comparison: Mortality Rate and Proportionate Mortality

- Deaths from heart disease in two communities, "A" and "B"

	A	B
Mortality rate from all causes	30/1,000	15/1,000
Proportionate mortality from heart disease	10%	20%
Mortality rate from heart disease	**3/1,000**	**3/1,000**

Comparison: Mortality Rate and Proportionate Mortality

- Deaths from heart disease in two communities, "A" and "B"

	A	B
Mortality rate from all causes	20/1,000	10/1,000
Proportionate mortality from heart disease	30%	30%
Mortality rate from heart disease		

Comparison: Mortality Rate and Proportionate Mortality

- Deaths from heart disease in two communities, "A" and "B"

	A	B
Mortality rate from all causes	20/1,000	10/1,000
Proportionate mortality from heart disease	30%	30%
Mortality rate from heart disease	**6/1,000**	**3/1,000**

Mortality Rate and Incidence Rate

- When is a mortality rate a good index of an incidence rate?
  - When case fatality rate is high
  - When the duration of disease is short

Years of Potential Life Lost (YPLL)

- **Years of potential life lost** measures the impact of mortality on society
- It is calculated by summing the years that individuals would have lived had they experienced normal life expectancy and had not died from the particular disease
- Often, age 65 (or 75) is used in the calculation
- For example, a person who died at age 30 from heart disease will contribute 65–30=35 YPLL
- YPLL is weighted more by premature deaths, while **crude mortality** is weighted by the larger number of deaths in older people
- $\text{YPLL rate per}100{,}000 = \frac{\text{sum}(65 - \text{age at death})}{\text{number of people 65 and younger}} \times 100{,}000$

Comparing First 5 Leading Causes of Death and YPLL

Causes of Death (U.S. 1990)	YPLL (U.S. 1990)
1. Heart diseases	1. Unintentional injuries
2. Malignant neoplasms	2. Malignant neoplasms
3. Cerebrovascular diseases	3. Suicide/homicide
4. Unintentional injuries	4. Heart diseases
5. COPD	5. Congenital anomalies

http://www.cdc.gov/mmwr/preview/mmwrhtml/00016649.htm

Review Questions

- City A has 200,000 inhabitants (midpoint population)
  - 400 of them had disease X
  - There were 1,000 deaths in one year
  - Of those 1000 deaths, 25 died from disease X
- What is the annual mortality rate?
- What is the annual mortality rate from disease X?
- What is the case fatality rate of disease X?
- What is the proportion of deaths from disease X?
- What is the annual prevalence of disease X?