BIOSTATISTICS AND EPIDEMIOLOGY

LESSON 10: DISEASE SURVEILLANCE & MEASURE MORBIDIT

BY: Shereena Opiniano, RMT,MSMT.

DISEASE SURVEILLANCE & MEASURE MORBIDITY

SURVEILLANCE

- Ongoing systematic collection, analysis & interpretation of health data essential to planning, implementation & evaluation of public health practice closely integrated with the timely dissemination of these data to those who need to know.

1.Passive surveillance
2.Active surveillance

1. PASSIVE SURVEILLANCE

- Denotes surveillance in which available data on reportable disease are used, or in which disease reporting is mandated or requested, with the responsibility for the reporting often falling on the health care provider or district health officer.

2. ACTIVE SURVEILLANCE

- Denotes a system in which project staff are recruited to carry to a surveillance program.
- They are recruited to make periodic field visits to healthcare facilities such as clinics &hospital in order to identify new cases of a disease or death from the disease that have occurred

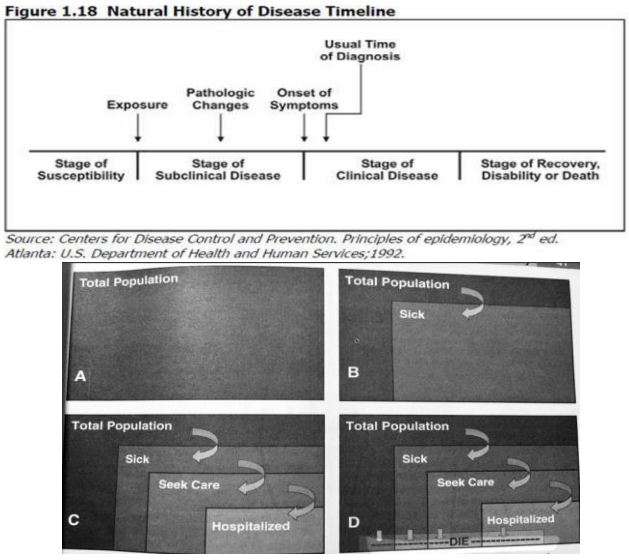
• PASSIVE SURVEILLANCE

➢Hospital based
➢Routine reporting

• ACTIVE SURVEILLANCE

➢Searching (hospital & community)
➢Routine reminders

STAGES OF DISEASE IN AN INDIVIDUAL & IN A POPULATION



RATES VS PROPORTION

- Rates
  ➢Tell us how fast disease is occurring in a situation
- Proportion
  ➢Tell what fraction of the population is affected

MEASURES OF MORBIDITY

INCIDENCE RATE

- No of new cases of a disease that occur during specified period of time in a population at risk for developing the disease.

$$\frac{\text{Number of new cases occuring in the population in a given period of time}}{\text{Total number of people in the same population during the same period of time}} \times 1{,}000 \text{ population}$$

2 TYPES OF DENOMINATOR:

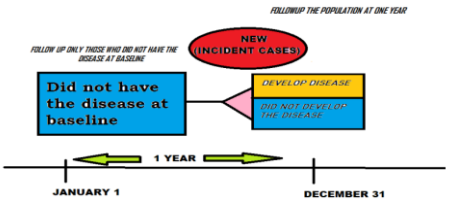
1. People at risk who are observed throughout a defined time period
2. When all people are not observed for the full time period, person-time

INCIDENCE RATE

DIFFERENT PERIODS OF TIME:

$$\frac{\text{Number of NEW cases of a disease occuring in a population during a specified period of time}}{\text{Total person-time (The sum of the time periods of observation of each person who has been observed for all or part of the time period)}} \times 1{,}000$$

IDENTIFYING NEW CASES IN ORDER TO CALCULATE INCIDENCE



ATTACK RATE

- **The term "attack rate" is often used instead of incidence during a disease outbreak in a narrowly-defined population over a short period of time.**
- Attack Rate $= \frac{\text{Number of new cases among the population during the period}}{\text{population at risk at the beginning of the period}} \times 100$

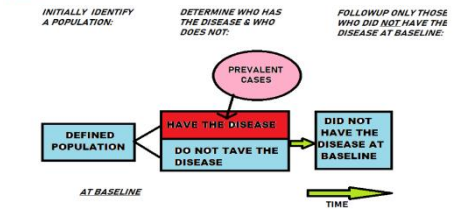
NOTE:
Does not explicitly specify the time interval because for many disease outbreaks we know that most cases occur within a few hours or a few days after the exposure

PREVALENCE

- Snapshot or a slice through the population at a point in time at which we determine who has the disease and who does not.

PREVALENCE per 1,000

$$\frac{\text{no. of cases of a disease present in the population at a specified time}}{\text{no. of person in the population at the specified time}} \times 1{,}000$$



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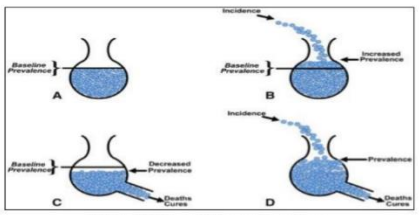
POINT PREVALENCE

- Prevalence of a disease at a certain point in time

PERIOD PREVALENCE

- How many people have had the disease at any point during certain period of time.

Prevalence Vs. Incidence



Relationship between incidence and prevalence.

PREVALENCE

- Not a measure of risk
- Valuable for planning health services

PROBLEMS WITH INCIDENCE

1. Problems with Numerators
2. Problems with denominators

PROBLEMS WITH NUMERATORS

- Defining who has the disease
- Ascertaining which persons should be included in the numerator.

TABLE 1: 1987 ACR Classification Criteria For RA

	1987 Classification Criteria
Criteria	1. Morning stiffness (at least one hour) 2. Arthritis in three or more joint areas 3. Arthritis of hand joints (≥1 swollen joints) 4. Symmetric arthritis 5. Rheumatoid nodules 6. Serum RF 7. Radiographic changes (erosions) on X-rays of hands
Applicable for	All arthritis patients
Results in	Classification of RA (yes/no)
Positive in case	Four of the seven criteria must be present. Criteria one through four must have been present for at least six weeks.
Test characteristics	Sensitivity of 79%–80% and specificity of 90%–93% for established RA. Sensitivity of 77%–80% and specificity of 33%–77% for early RA.

TABLE 2. *New York Criteria for Rheumatoid Arthritis.*

POINT	CRITERION
1	History of episode of 3 painful limb joints*
2	Swelling, limitation, subluxation or ankylosis of 3 limb joints: Must include hand, wrist or foot Must include symmetry of 1 joint pair Must exclude distal interphalangeal, 5th proximal interphalangeal, 1st carpometacarpal, 1st metatarsophalangeal & hips
3	X-ray changes (erosions)
4	Serum positive for rheumatoid factors

*Each joint group, for example, proximal interphalangeal counted as 1 joint, each side being scored separately.

POSSIBLE SOURCES OF ERROR IN INTERVIEW SURVEYS

1. Problems due to difficulties in diagnosis
2. Problems associated with study participants
3. Problems associated with interviewer

PROBLEMS WITH DENOMINATORS

- Undercounting of certain groups in the population may occur
- Eg. yOung men in minority groups have been missed inb many parts of the population
- Determine whether a certain group have higher than expected risk of disease so that appropriate preventive measure can be directed to the group.

PROBLEMS WITH HOSPITAL DATA

SOME LIMITATIONS OF HOSPITAL DATA
1.Hospital admissions are selective in relations to: a. Personal characteristics b. Severity of disease c. Associated conditions d. Admission policies
2. Hospital records are not designed for research They may be : a. Incomplete, illegible, missing b. Variable in diagnostic quality
3. Population (s) at risk (denominator) are generally not defined.

RELATIONSHIP BETWEEN PREVALENCE & INCIDENCE

Hypothetical Example of Chest Xray Screening: III. Prevalence, Incidence, and Duration

Screened Population	Point Prevalence per 1,000	Incidence (Occurences/yr)	Duration (yrs)
Hitown	100	4	25
Lotown	60	20	3

Prevalence= Incidence X Duration of disease

CONCLUSION

- Hitown has higher prevalence than Lotown people not because the risk of disease, but because affected Hightown people survive longer, the prevalence of disease (incidence x duration) is therefore higher in Hitown than Lotown people.

SPOT MAPS

- One approach to examining geographic or spatial differences in incidence is to plot the cases on a map, while each point representing a case.

• End.

MORTALITY & OTHER MEASURES OF DISEASE IMPACT

MEASURES OF MORTALITY

1. Mortality rates
2. Case fatality
3. Proportionate mortality
4. Years of potential life lost

A. MORTALITY RATES

1. ANNUAL DEATH RATE/ MORTALITY RATE FROM ALL CAUSES

Annual mortality rate of all causes (per 1,000 population) =

$$\frac{\text{Total no. of deaths from all causes in 1 year}}{\text{No of persons in the population at midyear}} \times 1{,}000$$

2. Age specific mortality rate

Annual mortality rate from all causes for children younger than 10years of age (per 1,000 population) =

$$\frac{\text{No. of deaths from all causes in one year in children younger than 10years of age}}{\text{Np of children in the population younger than 10 years of age at midyear}} \times 1{,}000$$

3. Cause- specific mortality rate

Annual mortality rate from lung cancer (per 1000 population)=

$$\frac{\text{No of deaths from lung cancer in 1 year}}{\text{No of persons in the population at midyear}} \times 1{,}000$$

Annual mortality rate from leukemia in children younger than 10 years of age (per 1,000 population)=

$$\frac{\text{No of deaths from leukemia in 1 year in children younger than 10years of age}}{\text{No of children in the population younger than 10 years of age at midyear}} \times 1{,}000$$

B. CASE FATALITY

- Percentage of people who have a certain disease die within a certain time after their disease was diagnosed.

Case fatality (percent)=

$$\frac{\text{No of individuals dying during a specified period of time after disease onset or diagnosis}}{\text{No of individuals with the specified disease}} \times 100$$

COMPARISON MORTALITY RATE WITH CASE FATALITY IN THE SAME YEAR

• Mortality rate:

- Denominator represents the entire population at risk of dying from the disease, including both those who have & do not have the disease

Case fatality:

- Denominator is limited to those who already have the disease

• Example

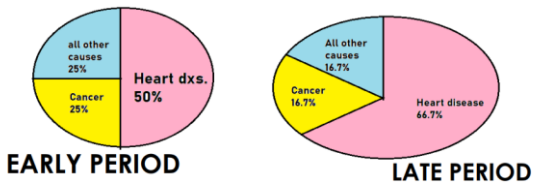
Assume a population of 100,000 people of whom 20 are sick with disease X, &in 1 year, 18 out of the 20 from disease X.

PROPORTIONATE MORTALITY

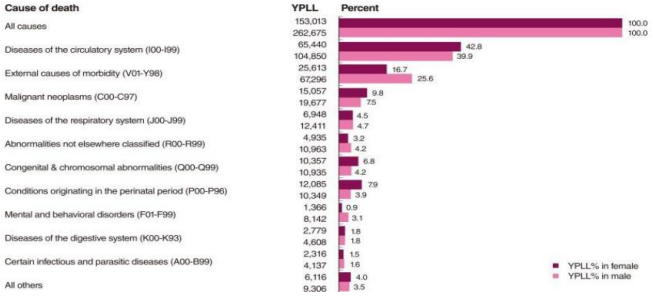
- Useful in identifying leading cause of death
- Gives relative importance of a specific cause of death in relation to all deaths

Proportionate mortality from cardiovascular disease in the US in 2010 (percent)=

$$\frac{\text{No of deaths from CVD in the U.S in 2010}}{\text{Total deaths in the U.S in 2010}} \times 100$$

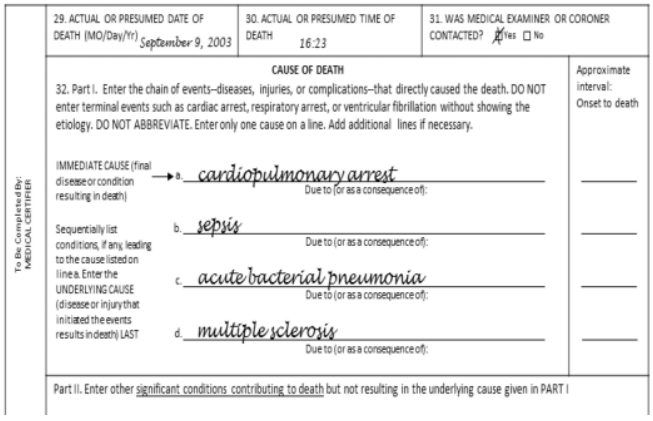


YEARS OF POTENTIAL LIFE LOST



DEATH CERTIFICATE

- Deaths are coded according to the underlying cause.
- UNDERLYING CAUSE
  - ➢ The disease or injury which initiated the train of morbid events leading directly or indirectly to death or the circumstances of the accident or violence which produced the fatal injury.



COMPARING MORTALITY IN DIFFERENT POPULATION

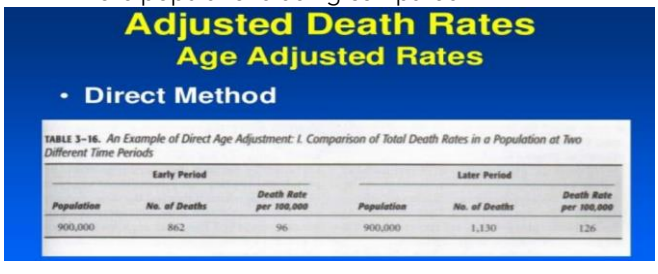
CRUDE MORTALITY RATES By race Baltimore City, 1965	
RACE	**MORTALITY per 1000 Population**
White	**14.3**
Black	**10.2**

DEATH RATES BY AGE & RACE , BALTIMORE CITY 1965							
Death rates by Age per 1,000 population							
RACE	**All ages**	**<1 yr**	**1-4 yrs**	**5-17 yrs**	**18-44yrs**	**45-64yrs**	**>65yrs**
WHITE	14.3	23.9	0.7	0.4	2.5	15.2	69.3
BLACK	10.2	31.3	1.6	0.6	4.8	22.6	75.9

- Crude mortality reflects both differences in the force of mortality. & differences in the age composition of the population.

DIRECT AGE ADJUSTMENT

- A standard population is used in order to eliminate the effects of any differences in age between two or more populations being compared.



Adjusted Death Rates
Age Adjusted Rates (cont'd)
• Direct Method

TABLE 3–17. *An Example of Direct Age Adjustment: II. Comparison of Age-Specific Death Rates in Two Different Time Periods*

Age Group (yr)	Early Period Population	Early Period No. of Deaths	Early Period Death Rate per 100,000	Later Period Population	Later Period No. of Deaths	Later Period Death Rate per 100,000
All ages	900,000	862	96	900,000	1,130	126
30–49	500,000	60	12	300,000	30	10
50–69	300,000	396	132	400,000	400	100
70+	100,000	406	406	200,000	700	350

Adjusted Death Rates
Age Adjusted Rates (cont'd)
• Direct Method

TABLE 3–18. *An Example of Direct Age Adjustment: III. Carrying Out an Age Adjustment Using the Total of the Two Populations as the Standard*

Age Group (yr)	Standard Population	"Early" Rate per 100,000	Expected No. of Deaths Using "Early" Rate	"Later" Rate per 100,000	Expected No. of Deaths Using "Later" Rate
All	1,800,000				
30–49	800,000	12	96	10	80
50–69	700,000	132	924	100	700
70+	300,000	406	1,218	350	1,050
Total no. of deaths expected			2,238		1,830

In the standard population age-adjusted rates:

$$\text{"Early"} = \frac{2,238}{1,800,000} = 124.3 \qquad \text{"Later"} = \frac{1,830}{1,800,000} = 101.7$$

DIRECT ADJUSTMENT

- Compare rates in at least two different populations when we wish to eliminate the possible effect of a given factor, such as age, on the rates we are comparing.

INDIRECT AGE ADJUSTMENT

- Often used when numbers of deaths for each age specific stratum are not available.
- Used to study mortality in occupationally exposed population

SMR (Standardized Mortality ratio)

- Ratio of the total number of deaths actually observed to the total number of deaths expected.

Computation of a SMR for TB . All forms (TBC) for white miners ages 20 to 59 years , US 1950				
	Estimeted population for White Miners	Death rate (per 100,000) for TBC in Males in the general population	Expected deaths from TBC in White Miners if they had the same risk as the general population	Observed Deaths from TBC in White Miners
AGE	*(1)*	*(2)*	*(3)= (1) X (2)*	*(4)*
20-24	74,598	12.26	9.14	10
25-29	85,077	16.12	13.71	20
30-34	80,845	21.54	17.41	22
35-44	148,649	33.96	50.55	98
45-54	102,649	56.82	58.32	174
55-59	42,494	75.82	31.96	112
TOTAL	**534,533**		**181.09**	**436**

$$\text{SMR} = \frac{\text{observed deaths for an occupation -cause-race group}}{\text{expected deaths for an occupation-cause-race group}} \times 100$$

$$\text{SMR (for 20-59 years old)} = \frac{436}{181.09} \times 100 = 241$$

POSSIBLE EXPLANATION OF TRENDS OR DIFFERENCES IN MORTALITY

- ☐ ARTIFACTUAL
- ☐ REAL

POSSIBLE EXPLANATION OF TRENDS OR DIFFERENCES IN MORTALITY

ARTIFACTUAL

1. **Numerator**
   - Errors in diagnosis
   - Erros in age
   - Changes in coding rules
   - Changes in classification
2. **DENOMINATOR**
   - Errors in counting the population
   - Errors in classifying demographic characteristics
   - Differences in percentage of
   - population at risk

REAL

- Change in survivorship without change in incidence
- Change in incidence
- Change in age composition of the population(s)
- A combination of the above factors.

• End.