Basic Measurements in Epidemiology

- *The concept of health used in this document was developed in 1947 by the World Health Organization (WHO) .*
- *It states that health is "a state of complete physical, mental, and social well being and not merely an absence of disease or informity"*

Health Indicators

- *To measure the health status of a community*
- *To compare the health status of country with that of another.*

Health indicators are measurement or metrics used to assess various aspects of individual or population health

- ***Characteristics of indicators**:*
- *Should be valid*
- *Should be reliable & objective*
- *Should be sensitive*
- *Should be specific*
- *Should be feasible*
- *Should be relevant*

Health indicator is a variable that reflects the state of health of a person in a community

Basic Measurements in Epidemiology

1. *Mortality indicators*
2. *Morbidity indicators*
3. *Disability rates*
4. *Natality Rate*
5. *Evaluation of presence, absence or distribution of disease*
6. *Measurement of medical requirements, healthcare facilities, health service usage and other health related occurrences*
7. *Measurement of Demography characteristics*
8. *Environmental indicators*

MORTALITY RATES AND RATIOS

- *These indicators focuses on death rate within a population. These includes :-*
- *Crude Death Rate*
- *Specific Death Rate*
- *Case Fatality Rate*
- *Expectation of Life*
- *Maternal Mortality Rate*
- *Infant Mortality Rate*
- *Child Mortality Rate*
- *Under 5 proportionate mortality rate*
- *Disease Specific Mortality*
- *Proportional Mortality Rate*
- *Survival Rate*

CRUDE DEATH RATE(CDR): *It indicates the rate at which people are dying. It is defined as the number of deaths in a year per 1,000 population, and is calculated using the formula:*

CDR= No. of deaths in a year/mid-year population x 1000

India CDR=7.416 (2023)

INFANT MORTALITY RATE (IMR)*: It refers to the number of deaths of infants (below one year of age) in a year per 1,000 live births.*

IMR = No. of deaths of children less than 1 year of age in a year/No. of live births in the same year/1,000

IMR=26.619(2023)

CHILD MORTALITY RATE: *It tells us about the number of children dying after the 1st birthday but before their 5th birthday.*

CMR= No. of deaths of children aged 1-4 years during a year/Total no. of children aged 1- 4 years at the middle of the year X 1,000

UNDER- 5 MORTALITY RATE: *Here we club all the deaths taking place before 5 years of age.*

UNDER 5= No. of deaths of children before 5 years of age/No. of live births X 1,000

MATERNAL MORTALITY RATE*: Death of women due to pregnancy, child birth etc.*

Maternal mortality ratio is the number of women who die from pregnancy-related causes while pregnant or within 42 days of pregnancy termination per 100,000 live births.

MMR=No. of death of females due to [pregnancy, child birth or within 42 days of delivery from related causes in an area during a given year/Total no. of live births in the same area and year X 100,000

MMR = 103PER 100,000 LIVE BIRTHS

CASE FATALITY RATE : *It is a measure of how deadly an illness is. It is commonly used in acute Infectious disease like Food Poisoning, Cholera and Measles.*

CFR=No. of death due to a particular disease/Total no. of cases due to the same disease X 100

DISEASE – SPECIFIC MORTALITY*: it is the simplest method of calculating the disease burden in a society. Mortality rates can be computed for particular diseases. The number of deaths due to a specific disease is expressed in terms of 1,000 or 1,00,000 population depending upon the number of deaths due to that disease.*

DSMR = DEATH FROM A SPECIFIC DISEASE X1000/MID YEAR POPULATION

TB mortality is 6 deaths per 100,000

EXPECTATION OF LIFE*: Life expectancy at birth is the "the average number of years that will be lived by those by those born into a population if the current age-specific mortality rates of the population persist.*

Specific death rates

1. Specific death rate due to tuberculosis $= \dfrac{\text{Number of deaths from tuberculosis during a calendar year}}{\text{Mid-year population}} \times 1{,}000$

2. Specific death rate for males $= \dfrac{\text{Number of deaths among males during a calendar year}}{\text{Mid-year population of males}} \times 1{,}000$

3. Specific death rate in age group 15-20 years $= \dfrac{\text{Number of deaths of persons aged 15–20 during a calendar year}}{\text{Mid-year population of persons aged 15–20}} \times 1{,}000$

4. Death rate for January $= \dfrac{\text{Deaths in January} \times 12}{\text{Mid-year population}} \times 1{,}000$
   (Note: The deaths are multiplied by 12 in order to make the monthly death rate comparable with the annual death rate)

5. Weekly death rate $= \dfrac{\text{Deaths in the week} \times 52}{\text{Mid-year population}} \times 1{,}000$

PROPORTIONAL MORTALITY RATE*: It is the number of deaths due to a particular disease or in a specific age group per 100 of total deaths.*

(a) Proportional mortality from a specific disease

$$\frac{\text{Number of deaths from the specific disease in a year}}{\text{Total deaths from all causes in that year}} \times 100$$

(b) Under-5 proportionate mortality rate

$$\frac{\text{Number of deaths under 5 years of age in the given year}}{\text{Total number of deaths during the same period}} \times 100$$

(c) Proportional mortality rate for aged 50 years and above

$$\frac{\text{Number of deaths of persons aged 50 years and above}}{\text{Total deaths of all age groups in that year}} \times 100$$

SURVIVAL RATE

It is the proportion of people who have survived after being examined and monitored for a specific period of time, such as five years in the case of patients.

$$\frac{\text{Total number of patients alive after 5 years}}{\text{Total number of patients diagnosed or treated}} \times 100$$

MEASUREMENT OF MORBIDITY

- *"Any departure, subjective or objective, from a state of physiological well-being".*
- *Morbidity refers to ill health. It includes incidence and prevalence of communicable and non communicable disease in a community.*
- *These indicators will give information about the proportion of people who are suffering from various diseases in the community, the possible cause of the disease, duration of illness and the length of these diseases in community.*
- ***Incidence:** It refers to the occurrence of new cases in a specified population within a specified time frame.*
- ***Incidence rate**: No. of new cases of specific disease during a given time period/population at risk X 1,000*
- ***Prevalence**: prevalence refers to the number of existing cases of a particular disease at one point of time, in a defined population.*

- *The following morbidity rates are used for ascertaining ill health in the community:*
  - *a) Incidence and prevalence*
  - *b) Notification rates*
  - *c) Attendance rates at outpatient department, health centres.*
  - *d) Admission, readmission and discharge rates.*
  - *e) Duration of stay in hospital*
  - *f) Spells of sickness or absence from work or school.*

INCIDENCE

- *Incidence= No. of new cases of specific diseases during a given period of time/population at risk*1000*
- *Eg. No. of new cases= 500*
- *Population= 30,000*

Incidence= 500X1000/30,000=16.7

Correct expression is 16.7 per 1000 per year

- *Incidence rate refers*
  - *only to new cases*
  - *during a given period (usually one year)*
  - *in a specified population or "population at risk", unless other denominators are chosen.*
  - *it can also refer to new spells or episodes of disease arising in a given period of time, per 1000 population.*

$$\text{Incidence rate (spells)} = \frac{\text{Number of spells of sickness starting in a defined period}}{\text{Mean number of persons exposed to risk in that period}} \times 1000$$

- *For example, a person may suffer from common cold more than once a year. If he had suffered twice, he would contribute 2 spells of sickness in that year.*

Uses:

- To control diseases
- For research into aetiology , pathogenesis and efficiency of therapeutic and preventive measures
- If incidence rate is increasing failure or ineffective for control of programme
- Rising incidence rate means -----need for new disease control

PREVALENCE

- ***Prevalence*** *is the* ***number of cases(old/new)*** *of a disease in a* ***specific population*** *at a* ***particular time point*** *or over a* ***specified period of time.***
- *A broader definition of prevalence is as follows: "the total number of all individuals who have an attribute or disease at a particular time (or during a particular period) divided by the population at risk of having the attribute or disease at this point in time or midway through the period ".*
- *When we talk about prevalence, we can either refer to 'point prevalence' or 'period prevalence'.*

- ***Point prevalence*** *is the proportion of people with a particular disease at a* ***particular time point*** *and can be calculated as follows:*

  Point prevalence= no. Of all cases (old/new)at a given point x100/estimated population at same point of time

- ***Period prevalence*** *is the proportion of people with given a particular disease during a* ***given time period****.*

  Period prevalence= no of cases during a given period of time x100/estimated mid interval population at risk

- *Prevalence is a useful measure of the burden of disease. Knowing about the prevalence of a specific disease can help us to understand the demands on health services to manage this disease.*
- *Prevalence changes when people with the condition are cured or die. Bear in mind that increased prevalence doesn't necessarily mean a bigger problem.*
- *Higher prevalence could mean a prolonged survival without cure or an increase of new cases, or both.*
- *A lower prevalence could mean that more people are dying rather than being cured, a rapid recovery, and/or a low number of new cases*

Morbidity rates used for assessing ill health in community are:

- *Incidence*
- *Prevalence*
- *Notification rate –it is calculated from reporting to public authorities of certain disease.*
- *Attendance rate at OPDs, health centres etc.*
- *Admission, readmission and discharge rates*
- *Spells of sickness or absence from work or school- reflects economic loss of the community.*

Disability rates

- *It includes incidence and prevalence of cases that are not able to perform full range activities because of some inherited or acquired problems. e.g.*
  - *a) Prevalence of blindness*
  - *b) Deafness and dumbness*
  - *c) Prevalence of paralytic*
  - *d) Poliomyelitis*
  - *e) Mental and socially handicapped*
  - *f) Sickness*
- *Bed disability days*
- *Work–loss days*
- *Sullivan's index: This index is calculated by subtracting from the life expectancy the probable duration of bed disability and inability to perform major activities*

Based on premises or portion that health implies a full range of daily activities.

- *Two groups:*

***1. Event type indicators**:*

– Number of days of restricted activity – Bed disability days

– Work-loss days within a specified period

***2. Person-type indicators**: –*

Limitation of mobility- confined to house or bed

– Limitation of activity (ADL)

- ***Sullivan's Index*** *– Expectation of life free of disability*
- ***HALE (Health Adjusted Life Expectancy)*** *– The equivalent number of years in full health that a newborn can expect to live based on current rates of ill-health and mortality.(normal +disabled)*
- ***DALY (Disability Adjusted Life Year)*** *– Number of years lost due to ill-health, disability or ill-health.*
- ***QALY (Quality adjusted life year)*** *– Number of years of life that would be added by a medical intervention.*

Nutritional Status Indicators

- *It includes :-*
- *Anthropometric measurement of pre- school children.*
- *Weight*
- *Height*
- *Mid arm circumference*
- *Height of children at school entry.*
- *Prevalence of low birth weight.*

- *Underweight----mortality rate increases if a child is underweight*
- *Stunting-result of long term nutritional deprivation----as a result of poor diet tend to be at greater risk for illness and death.*
- *Wasting_-----symptom of acute undernutrition----wasting impairs the functioning of immune system.*
- *Overweight--- child obesity is associated with obesity in adulthood------diabetes and cardio vascular disease*

Health care delivery indicators

- *These indicators reflect the equity of distribution of health resources in different parts of the country*
- *It includes :-*
- *Doctor : population ratio*
- *Doctor : nurse ratio*
- *Population : bed ratio*
- *Population per traditional birth attendant*

Utilization Rate

It is referred to the utility of the services health care programmes can be judged by record and reports maintained by health professionals.

Expressed as proportion of people in need of health care services who actually receive it in a given period.

- ✓ *Proportion of infants who are fully immunized .*
- ✓ *Percentage of population using the various methods of family planning.*
- ✓ *Proportion of pregnant women who receives antenatal care.*
- ✓ *Bed occupancy rate {i.e., average daily in-patient census/average number of beds)*
- ✓ *average length of stay (i.e., days of care rendered/ discharges), and*
- ✓ *bed turnover ratio (i.e., discharges/average beds).*

Indicators of Social & Mental Health

- *It includes indicators of social pathology:-*
- *Suicide*
- *Homicide*
- *Other acts of violence*
- *Other crime etc*
- *Alcohol and drug abuse, etc.*
- *The events indicating social and mental pathology are suicide, homicide, juvenile delinquency, alcohol and drug abuse, road traffic accidents, smoking, family violence*

Indicators of quality of life

- *Physical Quality of Life Index (PQLI): It takes three factors into consideration i.e.* ***infant mortality rate, life expectancy at the age of one year, and literacy rate. It is measured against a scale of 0 to 100***
- *Higher scores indicate better quality of life.*
- *PQLI=89.56(2020)*

Components of PQLI	Indicator
Life expectancy	The number of years a newborn can expect to live, on average
Infant mortality rate	The number of infants who die before reaching the age of one, per 1,000 live births
Literacy rate	The percentage of people aged 15 and above who can read and write

Environmental indicators

- *Reflects quality of physical & biological environment.*
- *– Proportion of population having access to safe water*
- *– Proportion of population having access to sanitation facilities*
- *– Indicators relating to pollution of air and water, radiation, solid wastes, noise.*

Socio Economic Indicators

It Includes :-

- *Rate of population increase*
- *Per capita GNP*
- *Level of unemployment*
- *Dependency ratio*
- *Family Size*
- *Housing the number of person per room*
- *Per capita Calorie availability*

Health Policy Indicators

- **Health policy means the health services which are specially designed for a particular age group, disease and health aspect for community welfare. The uses of these policies indicators that how much a person is aware about the health policies and the records of health policy indicator the utilization of health policies.**
- *Important Indicator of political commitment* • *"Allocation of adequate resources"*
- *– Proportion of GNP spent upon health services*
- *– Proportion of GNP spent upon health-related activities –*
- *Proportion of total health resources devoted to primary health care.*