

Lecture on Screening

By

Dr.Iffat Tehseen.

Learning Objectives

By the end of this session the students should be able to

- Define screening
- Discuss the the concept, aims and objectives of screening
- Discuss the rationale for selection of a screening test
- Calculate the sensitivity, specificity, positive and negative predictive value of a screening test.
- Describe different types of screening programmes and their evaluation
- Discuss the uses of screening

Screening

- “The process of search of unrecognized disease, defects by rapidly applied tests, examinations and other procedures to apparently healthy individuals.”

Basis of Screening

- **Screening in the context of community medicine.**

Recap of the subject

- **Goal of medical sciences**

Health development

Health improvement

How health can be improved

(public health approach)

- Paying responsibility in health
- Provision of health care
- Disease control measures
- Disease prevention

2. Provision of health care

(Comprehensive healthcare)

- **Preventive healthcare.**
- **Promotive healthcare.**
- **Curative healthcare.**
- **Rehabilitative healthcare**

3. Disease control

- **Decrease the incidence of disease.**
- **Decrease the duration of disease.**
- **Prevent / minimize the complication of dis-.**
- **Prevent / minimize the spread of disease.**

4. Levels of prevention

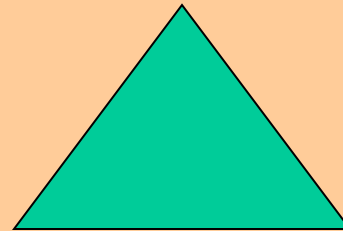
(Basic public health approach)

- **Wider application.**
- **Based on ecological triad.**

Agent

Host

Environment.



Three levels of prevention

(Five modes of intervention)

Needs conceptual building

- **1. PRIMARY.**
 - > **Disease has not started but perquisites are present.**
 - > **Objective is to prevent the disease altogether**
 - > **Major area of concern of Com:Medicine**
 - > **Potential area of preventive medicine**
 - > **Highly fruitful to Younger age**

2 . Secondary

- **In strictly speaking, applicable to certain diseases (potential natural history)**
- **Early dis- detection needs special measures like**



Screening

- **Objectives;**
 - * Prevention of advance disease with grave complications
 - * Minimize disease spread
 - * Even applicable to General / acute conditions (clinical area)
- **Role of clinical medicine starts.**

3 . Tertiary

- **Disease has gone through its cycle(In advanced stage).**
- **Man can not be left at mercy of nature...**
- **Address sufferer with incurable conditions**
- **Objectives;**
 - > **prevent /minimize grave complications**
 - > **Prevent / minimize Dependency...**

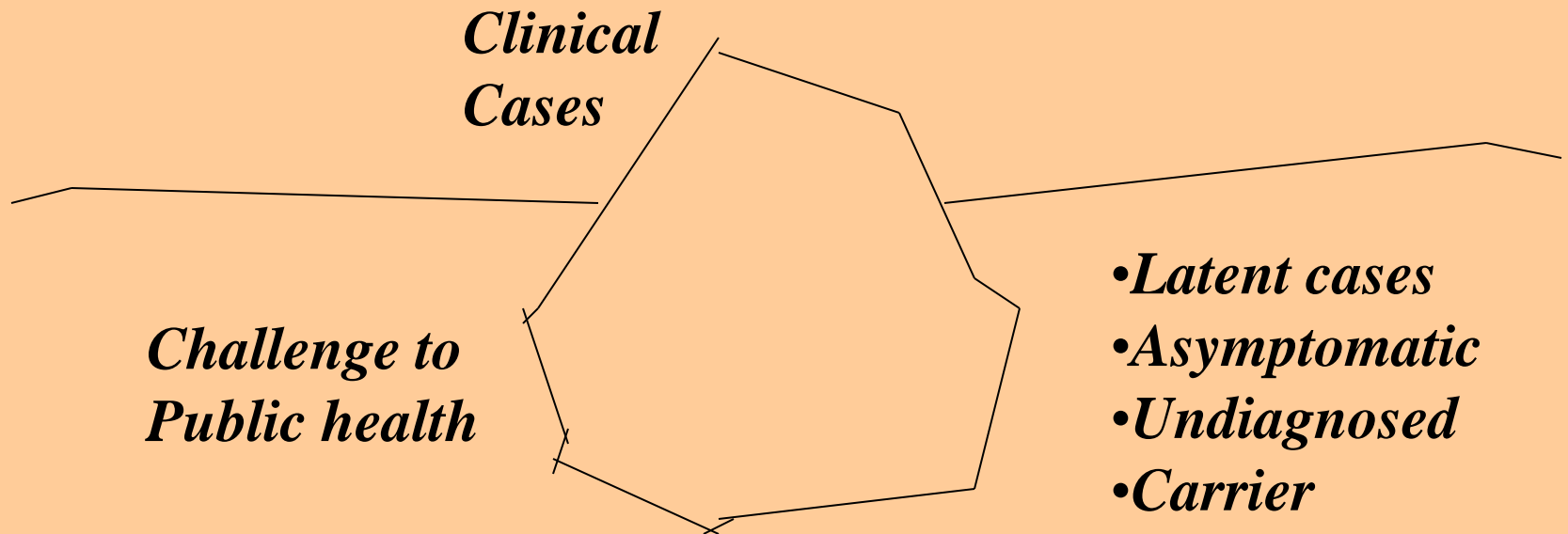
Physical..	at Individual level
Psychological..	at Family level
Economic	at community & state level.
 - > **Clinical & Rehabilitation medicine play major role.**

Aims & objectives of screening

- **To identify .. convert disease for better prognosis.**
 - .. **High risk individuals**
 - .. **for risk modification.**
 - .. **potential sources of disease spread.**
- **To reduce overall incidence of disease, and mortality and morbidity associated with disease.**
- **Types of screening**
 - **Mass screening**
 - **Multiphase screening**
 - **High-risk screening**

“Iceberg phenomenon” of diseases

- **(Titanic)**



Important public health measure

Applicable to certain diseases

Criteria for the Disease

Should be an important health problem with high Prevalence

Should have recognizable latent or early symptomatic stage

Adequately understood natural history of the disease

Availability of a reliable , accurate test that can detect the disease prior to onset of signs and symptom

Available facilities for confirmation of the diagnosis

Availability of effective treatment

Agreed on policy concerning whom to treat as patient (e.g lower ranges of B.P, borderline Diabetese

Concept of screening

(Understandable by knowing;)

- 1. Natural history of diseases.**
- 2. Pattern of diseases in the community.**

Natural history of diseases

(Provides rationale for screening test)

- **“Quantitative expression of the way how a disease evolves over time from the earliest stage of its initiation up to its termination as recovery, disability or death, in the absence of prevention or treatment.”**

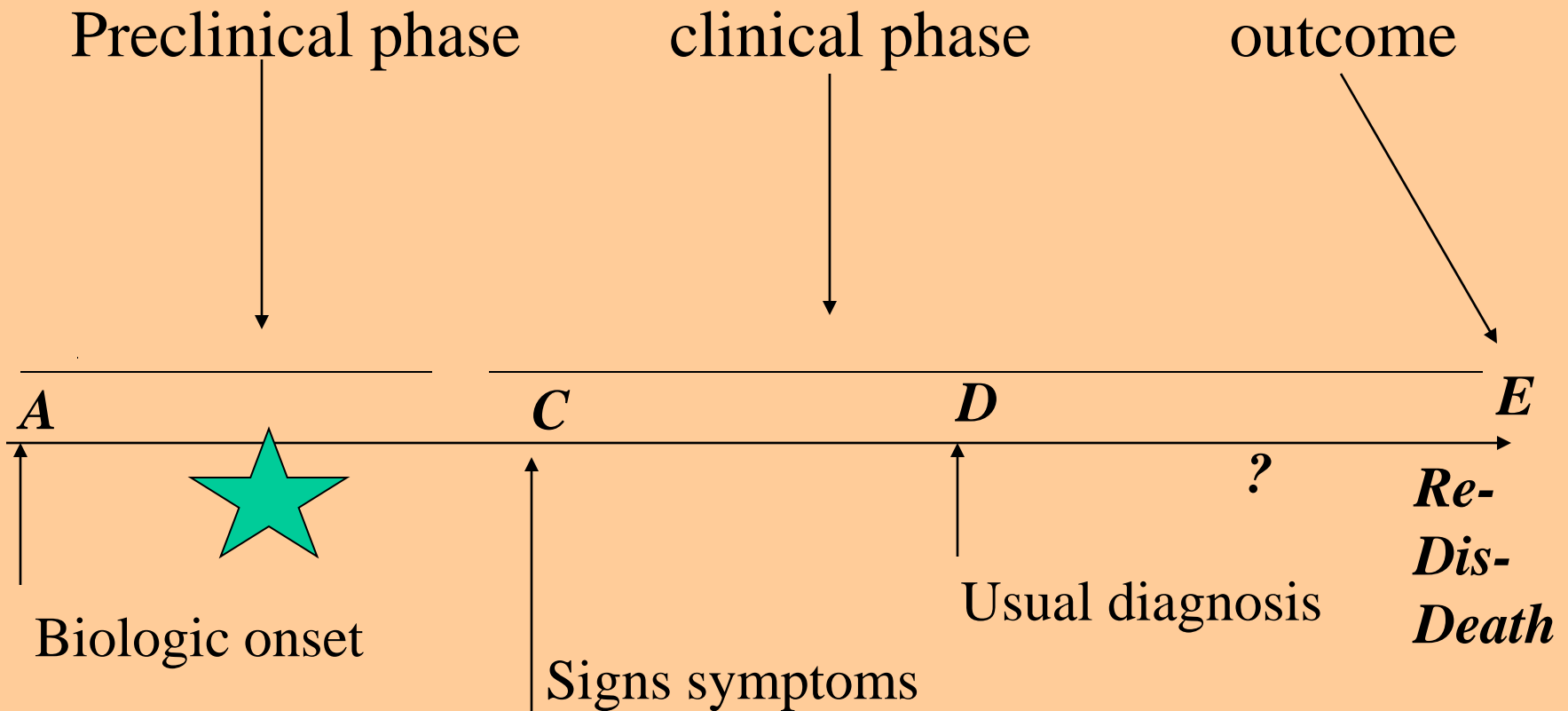
Course of the disease

Severity/ prognosis

Employing health intervention

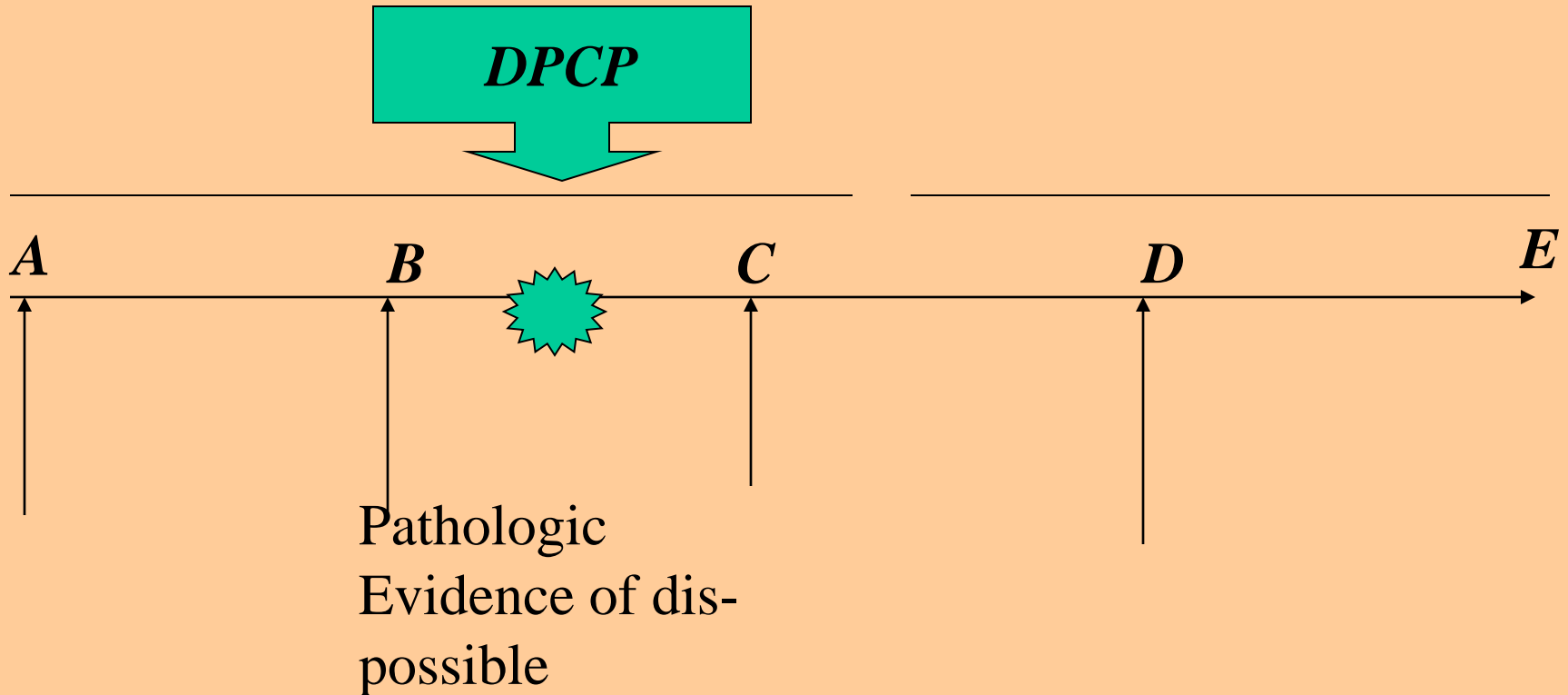
Known through cohort studies.

Schematic diagram of nat-h/o diseases



Rationale for screening test

- Detectable preclinical phase



“Lead time” of Screening test

- **Disease detection without screening**



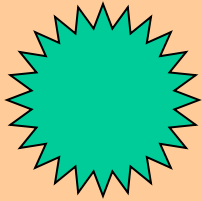
A *C / D* (outcome is usual)

- **Disease detection with screening**



(Early diagnosis, better outcome)

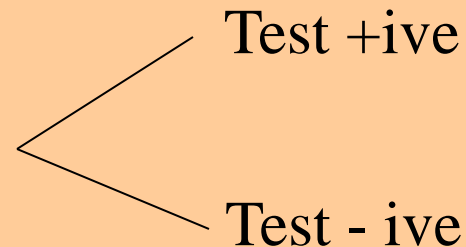
Lead time of screening test is the time between detection of disease by screening and the usual time of diagnosis



“Critical point”

- “A point in the natural history of diseases before which treatment is more effective or less difficult to administer or cure is possible but not after that point”.
 - > A theoretical concept
 - > Must be well before the stage of usual diagnosis

- **What does a screening test do ?**
Divides the population



Is this should be accepted as such !

Health intervention is imminent
Be rational and scientific

Is there any assumption or risk?

- Yes !

ASSUMPTION

- All test positive have the disease.
- All test negative do not have the disease.

RISKS

Some test-positive may not have the disease

False positive (FP)

Some test negative may have the disease

False negative (FN)

CONSEQUENCES

- **False positive.**
 - > **Psychologic trauma. (HIV,IHD)**
 - > **Stigma. (STDs, T.B)**
 - > **Economic burden (treatment,C.test)**
 - > **Employment problems.**
- **False negative.**
 - > **Time of effective intervention is lost.**
(Ca- cervix)
 - > **Potential source of dis- spread is missed.**
(HBV,HIV,)

Reasons behind variations

- **Perfection**

Relative term

Failure

System failure

Human failure

- **Screening Tests.**

Relatively less powerful.

Other sources of variations.

Subject vari-, Observer vari-, Instrumental-error

Inference

- **Extent of truth and non-truth should be
KNOWN &
MEASUREABLE**
- **Needed while interpreting test results.**
- **Selecting a test**

Screening

CRITERIA OF SCREENING TESTS:

- **Acceptability**
- **Repeatability**
- **Validity**
- **Widely applicable**
- **Simple**
- **Rapid**
- **Safe**
- **Inexpensive**
- **Non-invasive**

Evaluation of a Screening Test

How it is known !

- **Validity**
- **Repeatability**

(S.tests are pre-tested)

Validity

Defined as

“To what extent a test accurately measures which it purports to measure”.

It expresses the ability of a test to separate or distinguish those who have the disease from those who do not .

Two components are measured .

- **Sensitivity**
- **Specificity**

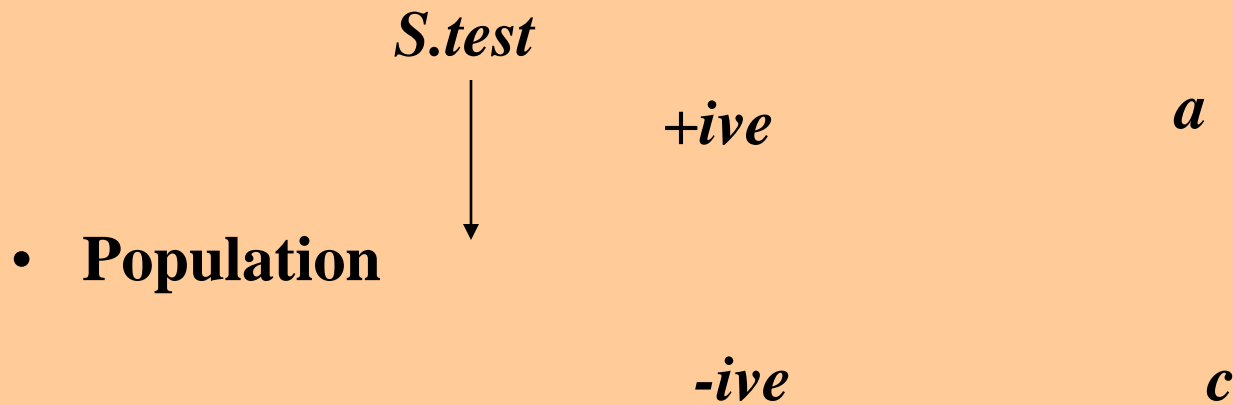
Sensitivity

- **“Ability of a S.test to identify correctly those who have the disease from all the diseased population”. (True positive)**

Specificity

- **“Ability of the test to identify those who do not have the disease from all the non-diseased population”. (True negative)**

Understandable by 2 bi 2 contingency table



(As actually happens in the real settings)

2 bi 2 table

(Gold standard)

← *Confirmatory test*

S.test

Dis-present

Dis-not present

+ive

a

b

-ive



c

d

$$\text{Sensitivity} = a / a + c \times 100$$

$$\text{Specificity} = d / b + d \times 100$$

(We are going to test a SCREENING TEST)

Predictive value of the s.test

(Public health issue)

- What %age of the diseased population will be identified by the test ?
- How much truth lies in the positivity of the test ?

Positive predictive value (PPV).

(predictive value of positive test)

Conti.....

- **What percentage of the non-diseased population will be identified as non-diseased by the given s.test ?**
- **How much truth lies in the negativity of the s.test ?**

Negative predictive value of test

(NPV)

(Predictive value of negative test)

2 bi 2 table

S.test	Dis-yes	Dis-no
positive	a	b
negative	c	d

$$\mathbf{PPV = a / a+b \times 100}$$

$$\mathbf{NPV = d / c+d \times 100}$$

Predictive accuracy of the screening test

(Diagnostic power of s.test)

- **Directly related with dis-prevalence.
(alpha feto-protein for spina- bifida)**
- **Directly related with sensitivity and
specificity of the screening test.**

Repeatability /Reproducibility

- **Test should give the same results, whenever and wherever it is conducted on the same individual or material under the same conditions.**
- **Reproducibility of screening test is more important property as compare to validity.**

Repeatability /Reproducibility

- Three major factors can affect
- Observer Variation
- Biological Variation

Continuous variable

- Variable

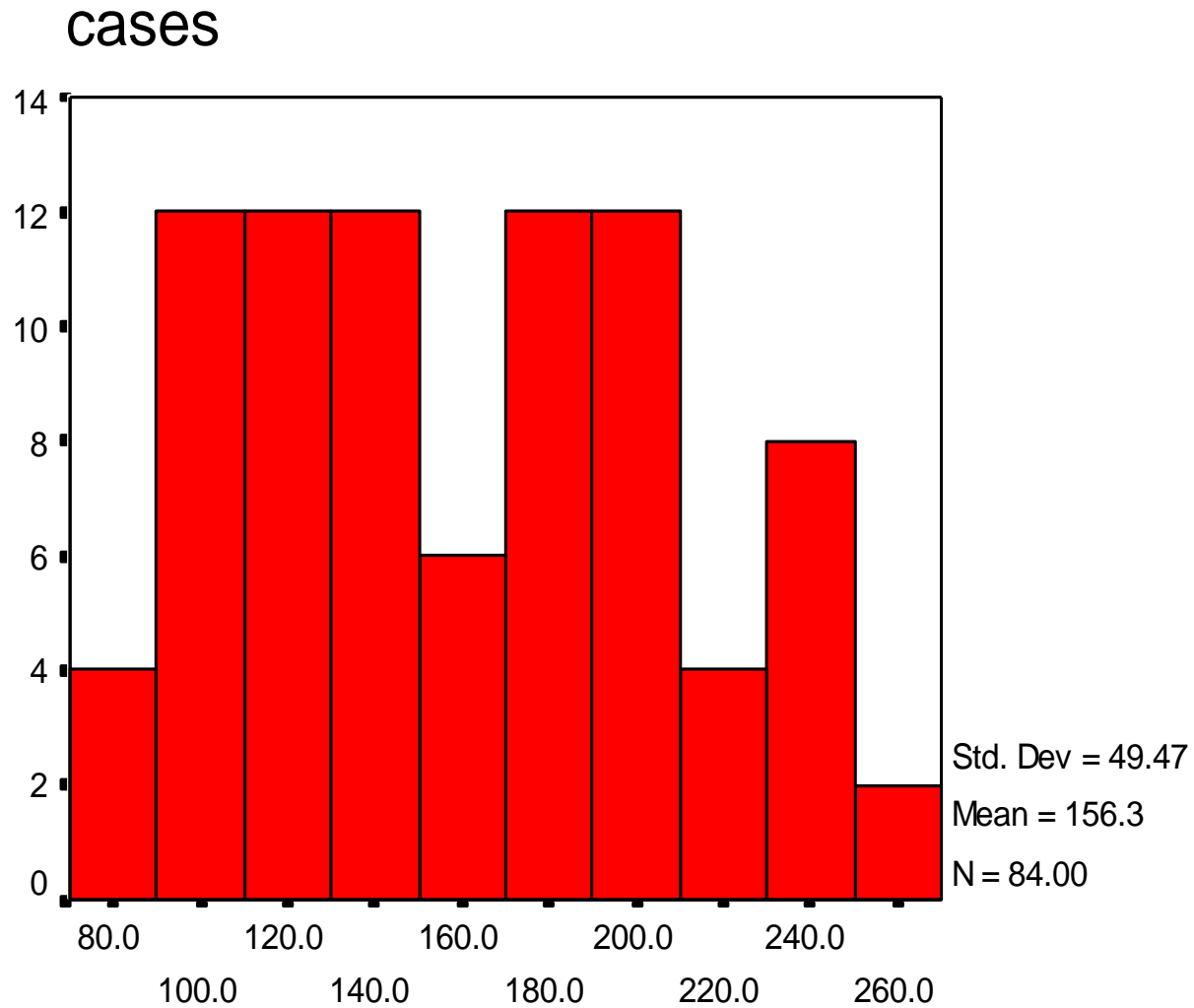
Discrete; can have certain value.

Continuous; can have any value
b/w certain values.

Human attributes

- Most, not fall in category of normal or abnormal but show variation with in certain limits with some degree of overlap (GREY AREA) .

Continuous variable & cut off point



cases

Boarder line cases

How it is addressed in screening!

- **Sensitivity and specificity are inversely related.**
- **Some, Compromise on specificity & sensitivity.**

“Cut-off point”

- **Decide a suitable point; Minimal FP & FN**
 1. **Based on statistical information,**
(previous studies & information's,
Prognostic record of given condition)

TREATABLE LEVEL &
NOT TREATABLE LEVEL

Conti...

- 2. Keeping in view;
 - = Problem of false +ive (FP).
 - = Problem of false –ive (FN).
 - = Availability of health interventions for the cases identified as diseased.
 - = Seriousness of the disease.
 - 3. Two stage screening.
 - 1st test relatively more sensitive ($\uparrow FP$)
 - 2nd test is relatively more specific ($\downarrow FN$)
- NET VALIDITY IS INCREASED**

Yield of Screening test

- Yield is the amount of previously unrecognized disease that is diagnosed as a result of screening effort.

Depends upon

- sensitivity
- Specificity
- Prevalence of disease
- Participation of the individual in the detection programme

Screening test and Diagnostic tests contrast

Screening Test	Diagnostic Test
Done on apparently healthy individuals	Done on those with indications or sickness.
Applied to groups	Applied to single patients, all diseases are considered.
Test results are arbitrary and final.	Diagnosis is not final but modified in light of new evidence, diagnosis is the sum of all evidences.
Based on one criterion or cut-off point.	Based on evaluation of a number of symptoms, signs and labortary findings.

Screening test and Diagnostic tests contrast

Screening Test	Diagnostic Test
Less accurate	More accurate
Less expensive.	More expensive.
Not a basis for treatment	Used as a basis for treatment
The initiative comes from the investigator or agency providing care.	The initiative comes from the Patient with the complaints.

Epidemiologic approach towards screening **(Benefits to peoples undergone screening)**

- **Issues**
- **Is disease detectable at early stage**
- **Sensitivity & specificity of s.test**
- **PPV & NPV of screening test**
- **How serious is the problem of FN & FP**
- **Cost of early detection**
- **Harmful effects of s.test**
- **Is case detected are provided with some health benefit**
- **Is intervention is more effective,economical,easy to apply (more understandable from surgical view)**

Evaluation of screening program

- **Public health function**

Satisfaction

Resources are scarce

Program justification

Political accountability

Weaknesses & strengths

- **Nothing but comparing the objectives
with the achievements.**

Operational measures(Process indicators)

(that tell us about the process of screening)

- No.& proportion of population screened**
- Detected prevalence of preclinical disease**
(added to total prevalence of disease)
- Proportion of test +ive brought to confirm diagnosis and (provided treatment).**
- Total cost of program**
- Cost per previously unknown case**
- Predictive value of the s.test in the population screened.**

Out come measures

(That tell about the impact of the program)

- Increase in %age of cases detected at earlier stage.**
- Reduction in case fatality in cases identified.**
- Decrease in complications in cases identified.**
- Reduction in the mortality by that particular disease in population screened.**
- Degree of improvement in overall quality of life of the screened.**