Screening

Chapter 6

Screening

- Screening people for disease — or risk factors which predict disease —is motivated by the potential benefits of secondary prevention through early detection and treatment.

- **Definition**

- Screening is the process of using tests on a large scale to identify the presence of disease in apparently healthy people.
- Screening tests do not usually establish a diagnosis.
- It establish presence or absence of an identified risk factor, and thus require individual follow –up and treatment.

Screening for Diseases to Assess BOD

Screening : Test for a disease in asymptomatic individuals

Why Screening?

For early detection of disease to allow effective treatment-reduce death/disability and increase survival rate *i.e* cancer

Example

Cancer	Screening test
Breast cancer	Mammography
Colon cancer	Occult blood in stool
Cervical cancer	PAP smear
Prostatic cancer	PSA

Criteria 1: Disease with High Death Rate/disability

Breast Cancer

Most common cancer causing death in women in their 50's

Colon Cancer

Common cause of death among men and women.

Screening is meant to be for severe fatal diseases only

Criteria 2: Early Detecion Improves Outcome

Lung cancer

Chest X-ray offers early detecion, but cure is too late (Lead-time bias)

- it is important that the screening test itself is very unlikely to cause harm.

- Screening can also be used to identify high exposure to risk factors.

- For instance, children's blood samples can be screened for lead in areas of high use of lead in paint.

- **Aims of screening tests**

- To determine the frequency or natural history of a condition

- To prevent the infectious diseases and protection of public

Criteria 3: Feasible Testing Strategy

First

Identify risk group: Women for breast cancer,
Men for prostatic cancer

Second

Multiple tests: Sequential (two-stage) test: distinguish FP and FN

a. First is screening: done to all-screening
b. Second is confirmatory: done ONLY for those who were positive by screening test

FP, false positive; FN, false negative

Types of screening

- **Mass screening** aims to screen the whole population (or subset);

- **Multiple or multiphasic screening** uses several screening tests at the same time;

- **Targeted screening** Of groups with specific exposures,e.g. Workers in lead battery factories, is often used in environmental and occupational health

- **Case-finding or opportunistic screening** is aimed at patients who consult a health practitioner for some other purpose.

Criteria for screening

Disorder	Well-defined
Prevalence	Known
Natural history	Long period between first signs and overt disease; medically important disorder **for which there is an effective remedy**
Test choice	Simple and safe

Criteria for screening

Acceptability	agreed upon and acceptable to both the screening authorities and to those screened
Equity	Equity of access to screening services; effective, acceptable and safe treatment available

The screening test

- The screening test itself must be cheap, easy
- acceptable to the public,
- reliable and valid.
- A test is reliable if it provides consistent results,
- A test is valid if it correctly categorizes people into groups with and without disease, as measured by its sensitivity and specificity.

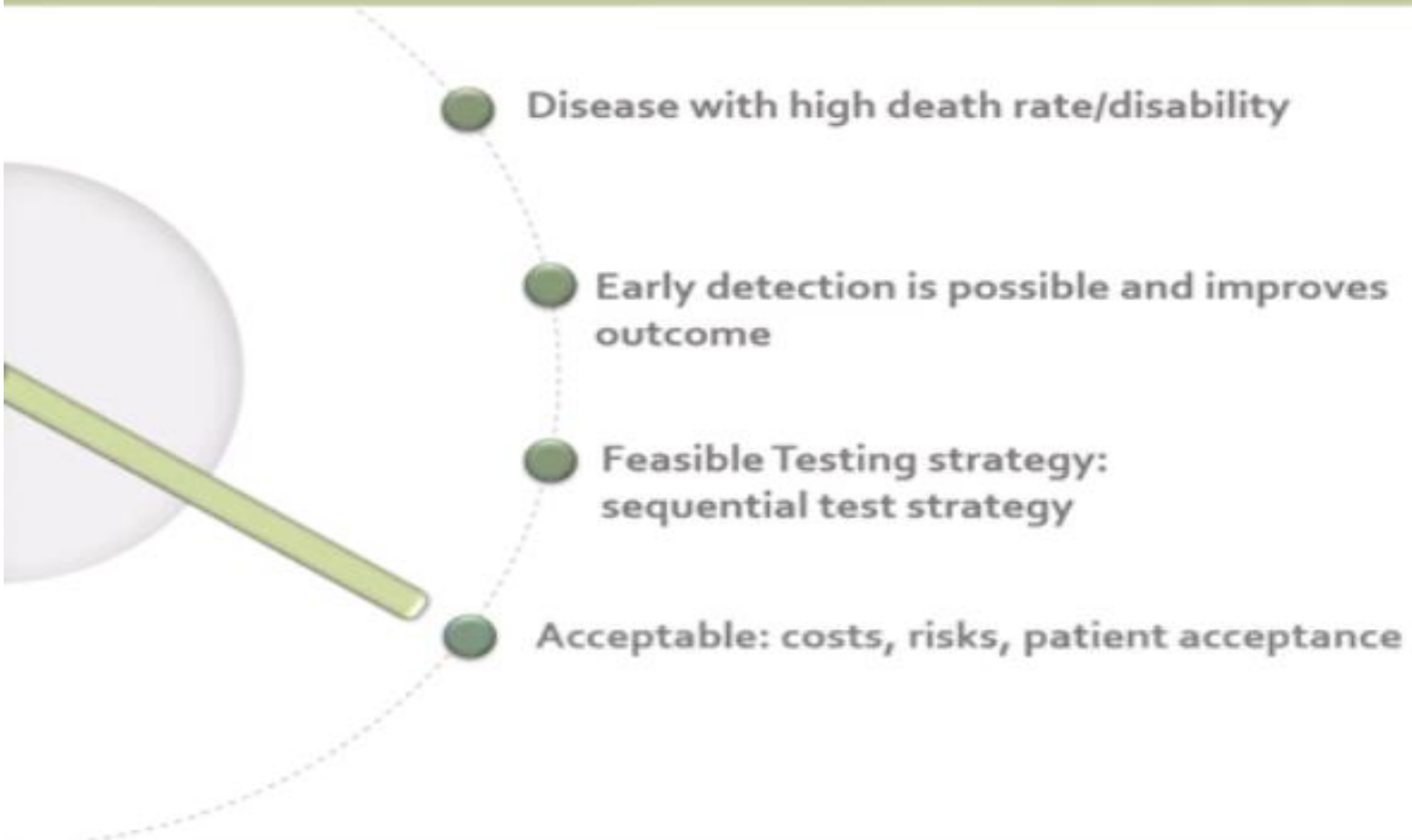
Criteria 4: Acceptibility

Patient acceptability: colon cancer test is inconvenient (invasive) for patient

Cost and frequency of test:
breast cancer once a year, but colon cancer once in two years

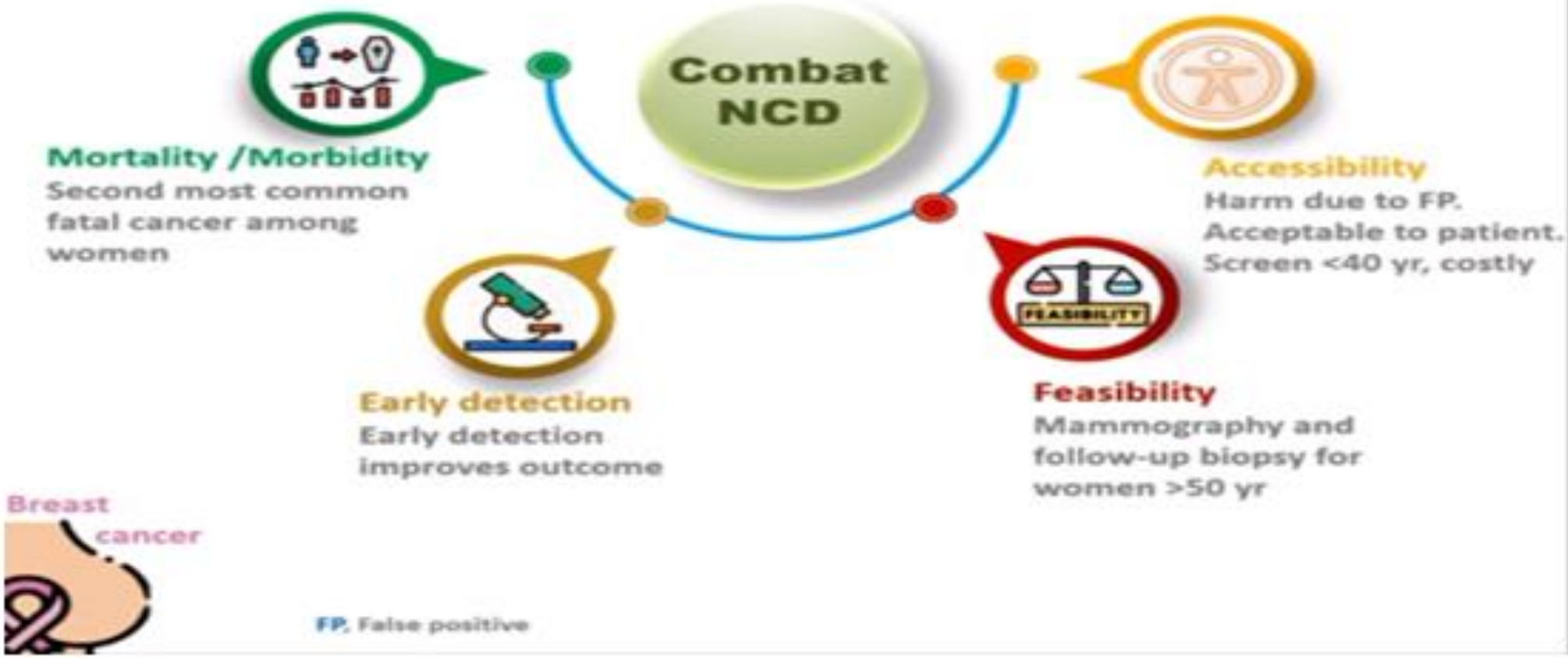
Invasiveness:
Physical examination, urine test, and blood test Vs catheterization and surgery

Ideal Screening Programm: Criteria



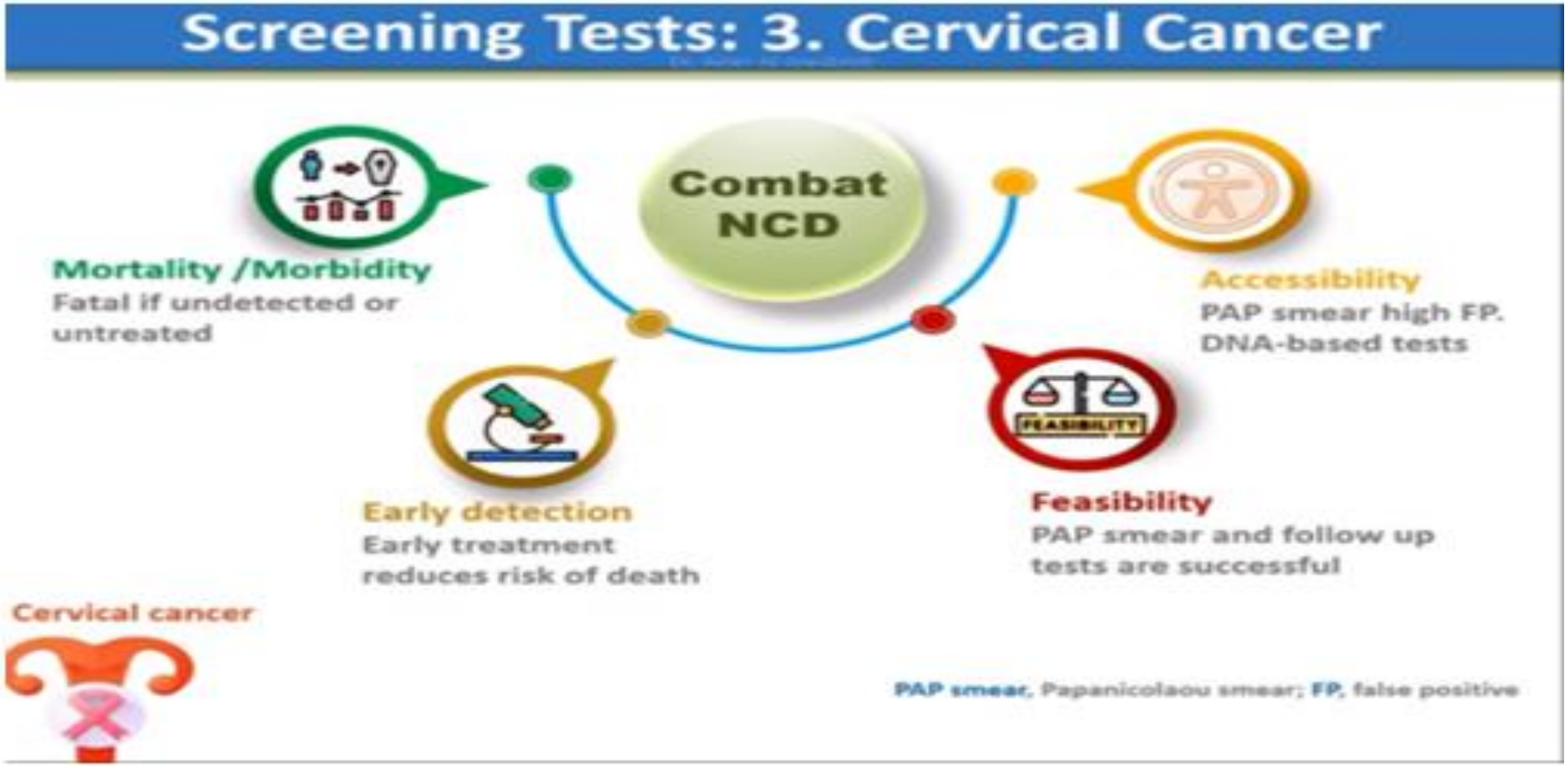
Screening Tests: 1. Hypertension

Screening Tests: 2. Breast Cancer



FP, False positive

Screening Tests: 3. Cervical Cancer



PAP smear, Papanicolaou smear; FP, false positive

Screening Tests: 4. Colon Cancer

Colon cancer

Validity of a screening test measurement

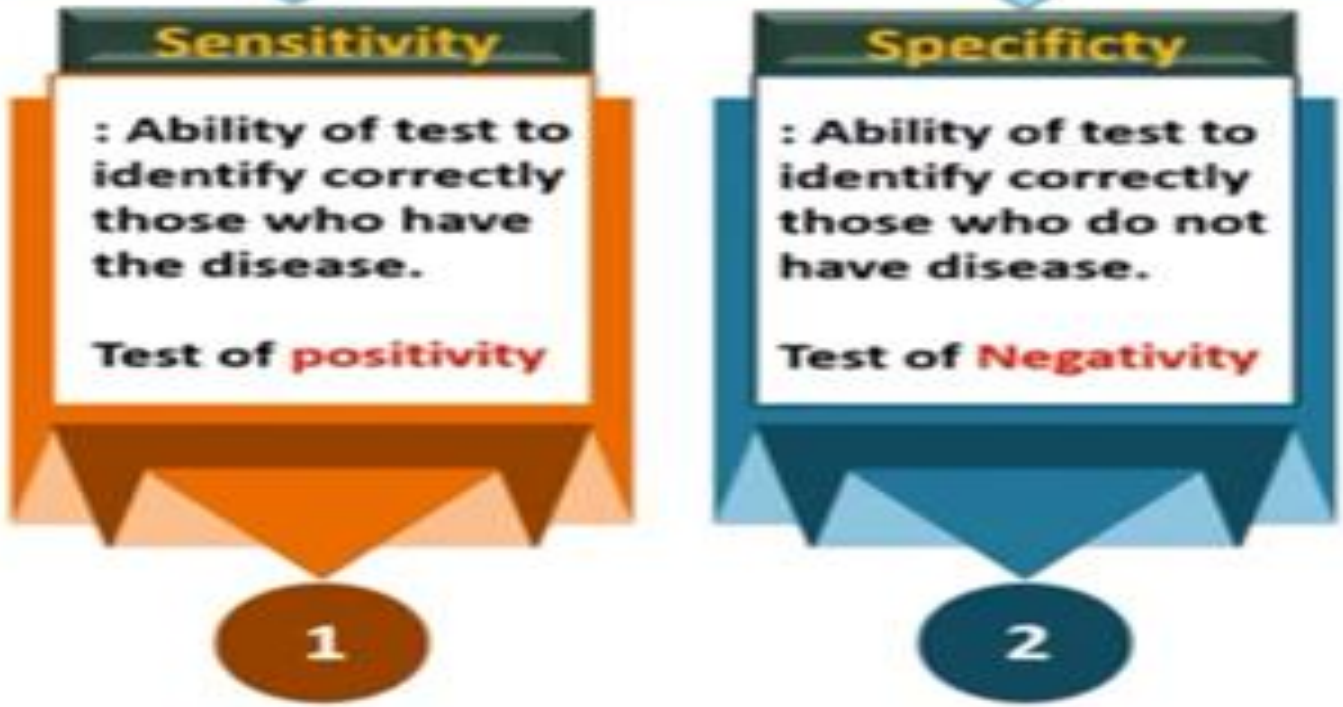
- **Sensitivity** is the ability of a test to identify correctly those who have the disease
- **(When the disease is present, how often does the test detect it?)**

- **Specificity** is the ability of a test to identify correctly those who don't have the disease

(When the disease is absent, how often does the test provide a negative result?)

Validity: Sensitivity and Specificity

Validity: Abilitiy to distinguish between diseaed and undiseaed



Predictive Values

PPV; Positive Predictive Value; NPV, Negative Predictive Value

Calculations: An Example

A population of 1,000 women. Prevalence of breast cancer is 10%.

Test did not catch 10 cancer cases, 90 of non-cancer subjects were positive

Disease Status

Test: Mammography	Cancer		No Cancer		
Positive	90	TP	90	FP	180
Negative	10	FN	810	TN	820
	100		900		1000

PPV (precision)= TP/(TP+FP)

NPV= TN/(TN+FN)

Sensitivity= TP/(TP+FN)

Specificity = TN/(TN+FP)

Accuracy= TP+TN/(TP+TN+FP+FN)

Sensitivity = 90/100= 90%

Specificity = 810/900= 90%

PPV = 90/180= 50%

NPV = 810/820= 98%

Accuracy = 90+810/1000= 90%

PPV; Positive Predictive Value; NPV, Negative Predictive Value; TP; True Positive; TN, True Negative; FP, False Positive; FN, False Negative;

Validity of a screening test

		Disease status		
		Present	Absent	Total
Screening test	Positive	a (T.P)	b (F.P)	a+b
	Negative	c (F.N)	d (T.N)	c+d
	Total	a+c	b+d	a+b+c+d

a = No. of true positives, b = No. of false positives,

c = No. of false negatives, d = No. of true negatives

- **Sensitivity** = probability of a positive test in people with the disease= a/(a+c)

- **Sensitivity** = $$\frac{\text{True positive (T.P)}}{\text{All dseased (T.P + F.N)}}$$

- **Specificity** = probability of a negative test in people without the disease= d/(b+d)

- **Specificity** = $\frac{\textbf{True negatives (T.N)}}{\textbf{All healthy (T.N + F.P)}}$

Example 5.1: Examination of blood sugar

	Diabetics	Non	Total
Test positive	350	1900	2250
Test negative	150	7600	7750
Total	500	9500	10,000

Example 5.1: Examination of blood sugar

	Diabetics	Non	Total
Test positive	350 TP	1900 FP	2250
Test negative	150 FN	7600 TN	7750
Total	500	9500	10,000

Principles of early disease detection

- The condition sought should be an important problem.
- There should & be an accepted treatment for patients
- Facilities for diagnosis and treatment should be available.
- The natural history of the condition should be understood.
- There should be a recognizable latent or early symptomatic stage.

Behavioral factors affecting participation in screening program

- Threat of the disease
- Relevancy to the people
- Expected actions