Screening

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Objectives of the lecture

- **Definition & concept of screening**
- **Aims and objectives of screening**
- **Types of screening**
- **Criteria for screening**
- **Evaluation of screening**

Iceberg Phenomenon of disease

The submerged portion of the iceberg represents the hidden mass of the disease(e.g. subclinical cases, carriers, undiagnosed cases)

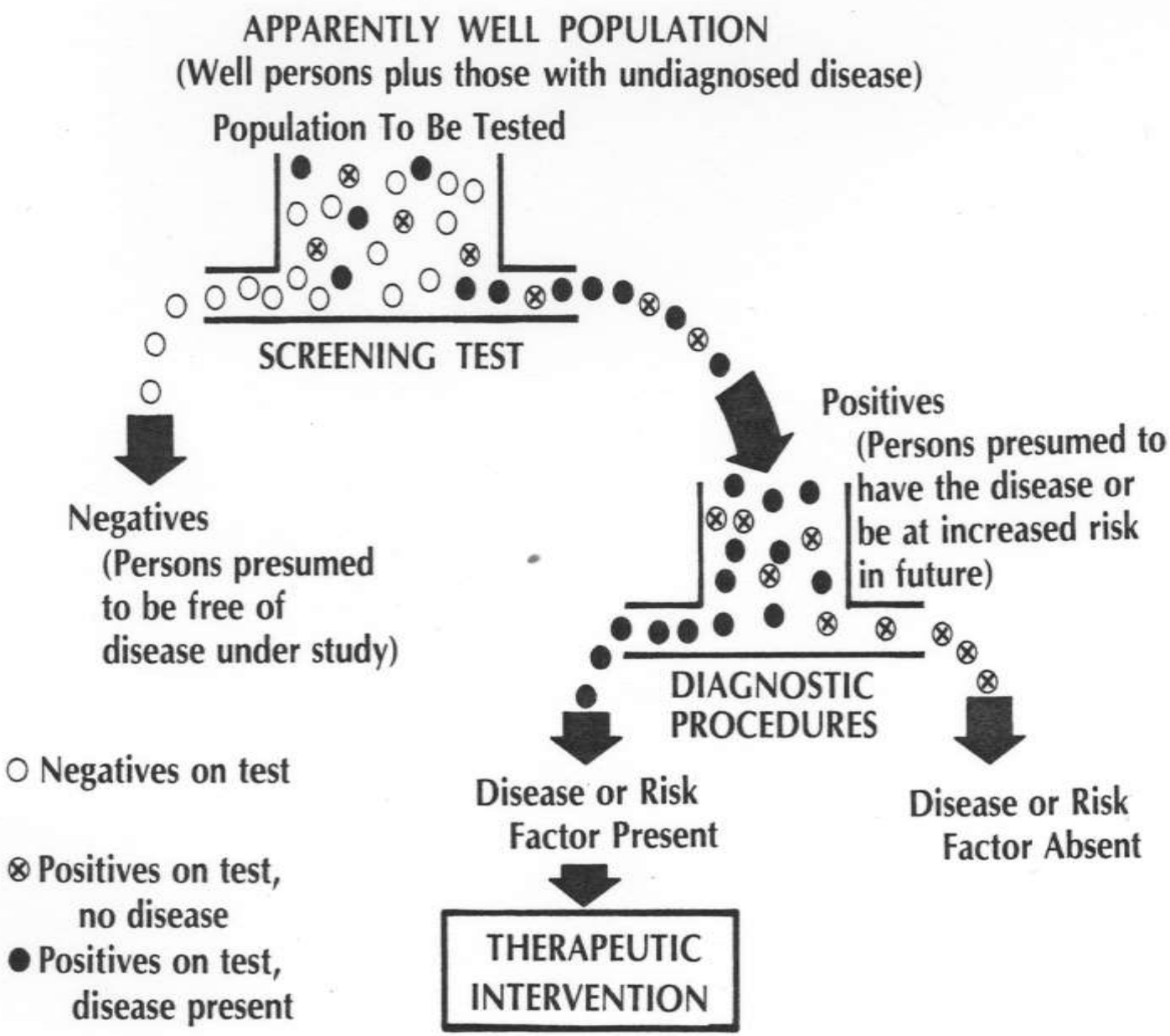
The floating tip represents what the physician sees in his practice

The hidden mass represents the unrecognized disease in the community

Definition & concept of screening

Screening is defined as:

“the search for unrecognized disease or defect by means of rapidly applied tests, examinations or other procedures in apparently healthy individuals”


APPARENTLY WELL POPULATION
(Well persons plus those with undiagnosed disease)
Population To Be Tested
SCREENING TEST
Negatives
(Persons presumed
to be free of
disease under study)
Positives
(Persons presumed to
have the disease or
be at increased risk
in future)
DIAGNOSTIC
PROCEDURES
Disease or Risk
Factor Present
Disease or Risk
Factor Absent
THERAPEUTIC
INTERVENTION
○ Negatives on test
⊗ Positives on test,
no disease
● Positives on test,
disease present

Screening and Diagnostic tests

Screening test	Diagnostic test
Applied on apparently healthy people	Done for sick individuals
Applied on groups	Applied to single patient
Less accurate	More accurate
Less expensive	More expensive
Not a basis of treatment	Used as basis of treatment
The initiative come from the investigator or agency providing care	The initiative comes from a patient with a complaint

Aims and objectives of screening

The basic purpose of screening is to:

"Sort out from a large group of apparently healthy persons those likely to have the disease or at increased risk of the disease to bring those who are abnormal under medical supervision and treatment

Screening: is testing for disease in population or in individuals who are not seeking health care

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Example: premarital screening for syphilis

Testing for AIDS in blood donors

Case finding: Use tests to detect disease in individuals seeking health care for other reason

Example: use of VDRL test to detect syphilis in pregnant women

Diagnostic tests: Use of clinical or laboratory procedures to confirm the existence of disease in patients with signs and symptoms of disease

Example: VDRL testing of patients with lesions suggestive of secondary syphilis

Types of screening

Mass screening

means screening a whole population (defined by geographical location, age groups or gender), for example, cervical screening for all women of reproductive age, screening adults for risk factors for chronic diseases .

Targeted (high risk) screening:

is screening a group of people who are more likely to have a particular problem, for example, screening for diabetes in a person who has a close family member with diabetes

Multiphasic screening:

It is application of two or more screening tests in combination to a large group of population at one time

Example: chemical and hematological tests on blood and urine test

Criteria for screening

Criteria of the disease to be screened

Criteria for the screening test applied

Criteria of the disease to be screened

- The condition being screened for should be an important health problem (high prevalence & serious)
- The natural history of the condition should be well understood
- There should be a detectable early stage
- There is an effective treatment
- Treatment at an early stage should be of more benefit than at a later stage
- Facilities should be available for confirmation of the diagnosis
- The risks, both physical and psychological, should be less than the benefits
- The costs should be balanced against the benefits

Criteria for the screening test applied

A. **Acceptability**

B. **Repeatability**

C. **Validity**

Acceptability

Simple

Safe

Rapid

Non invasive

Non painful

Cheap

Accepted to the population

Repeatability

The test must give consistent results when repeated more than once on the same individual

It is also called reliability of the test

The repeatability of the test depends on three major factors:

1- Observer variation

2- Subject (biological) variation

3- technical method variation

Criteria for Evaluating a Screening Test

- **Validity**: provide a good indication of who does and does not have disease
  - -Sensitivity of the test
  - -Specificity of the test
- **Reliability**: (precision): gives consistent results when given to same person under the same conditions
- **Yield**: Amount of disease detected in the population, relative to the effort
  - -Prevalence of disease/predictive value

Validity of screening test

1- Sensitivity

2- specificity

3 positive predictive value

4- negative predictive value

5- prevalence

Validity of Screening Test

- Sensitivity:

Is the test detecting true cases of disease? (Ideal is 100%: 100% of cases are detected)

= TP/ TP+ FN

-Specificity:

Is the test excluding those without disease? (Ideal is 100%: 100% of non-cases are negative)

= TN/ TN + FP

	Diseased	Not diseased	
Screening test positive	TP	FP	TP+FP Total +ve
Screening test negative	FN	TN	FN+TN Total -ve
	TP+FN Total diseased	FP+TN Total not diseased	Grand total

	Disease or Condition	No Disease or Condition
Test Positive	A True Positive	B False Positive
Test Negative	C False Negative	D True Negative

Sensitivity:

The probability of the screening test to be positive when the disease is truly present i.e. the percent of those who have the disease and so indicated by the test.

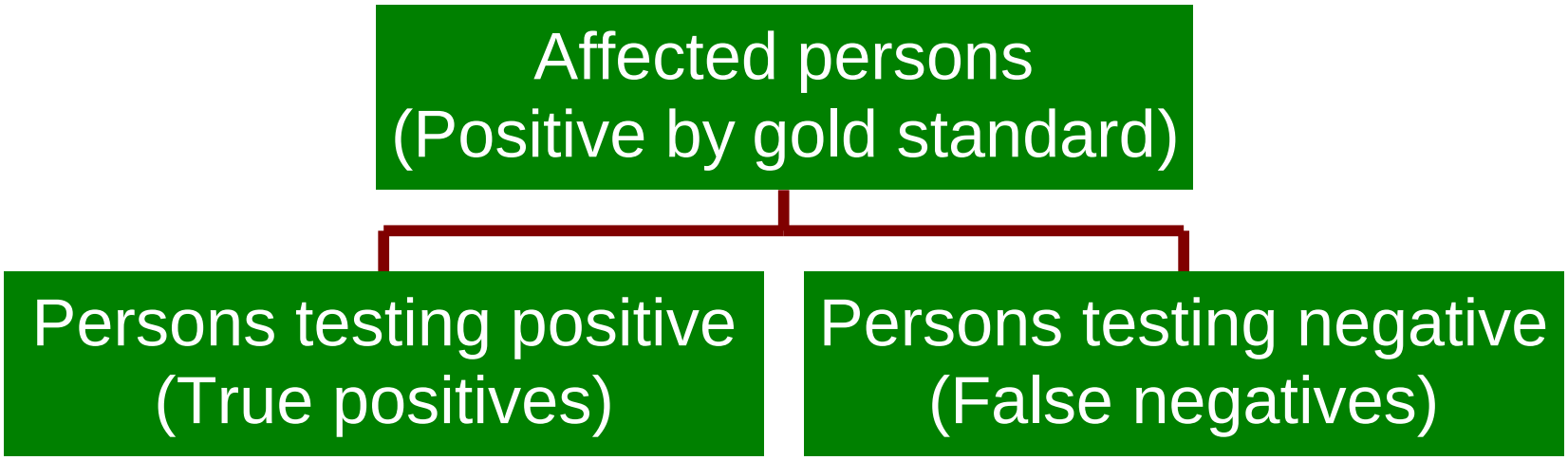
$$\text{Sensitivity} = \frac{\text{True positive (a)}}{\text{True positive (a) + False negative (c)}} \times 100$$

$$\text{i.e. Sensitivity} = \frac{\text{Persons with the disease detected by the screening test}}{\text{Total number of persons tested with the disease (validating test)}} \times 100$$

Sensitivity

The sensitivity of a test in the ability of the test to identify correctly affected individuals

Proportion of persons testing positive among affected individuals



Sensitivity = True positives / Affected persons
Estimate the 95% confidence interval

Specificity:

The probability of the screening test to be negative when the disease is truly absent i.e. the percent of those who do not have the disease and are so indicated by the test.

$$\text{Specificity} = \frac{\text{True negative (d)}}{\text{True negative (d) + False positive (b)}} \times 100$$

Persons without the disease who are negative

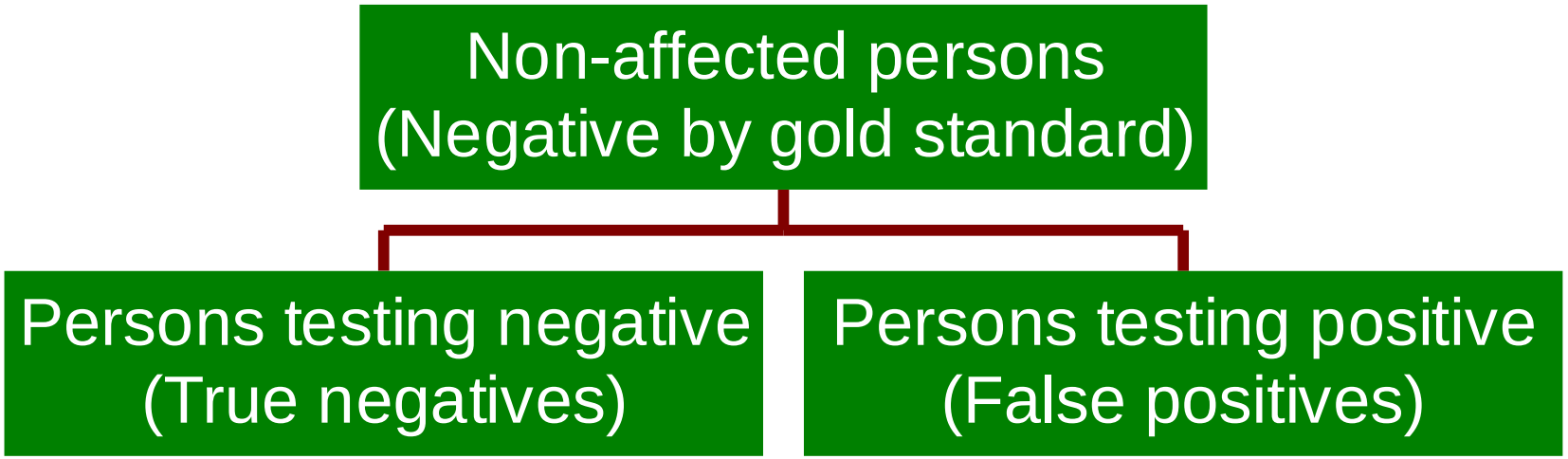
By the screening test

$$\text{i.e. Specificity} = \frac{\text{Persons without the disease who are negative By the screening test}}{\text{Total number of persons tested without the disease}} \times 100$$

Specificity

The specificity of a test in the ability of the test to identify correctly non-affected individuals

Proportion of person testing negative among non affected individuals



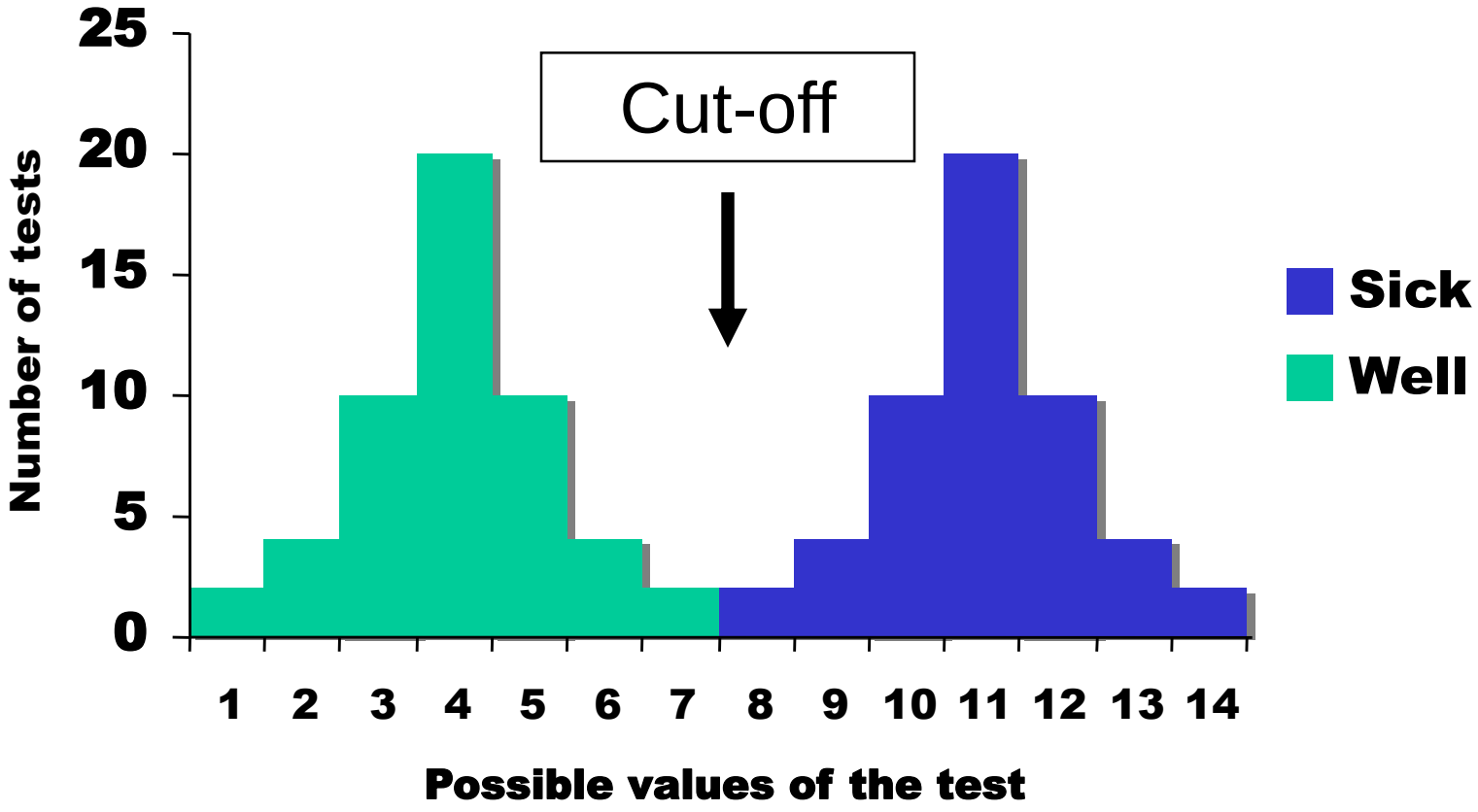
Specificity = True negatives / Non-affected persons
Estimate the 95% confidence interval

Basic concepts of cut off points

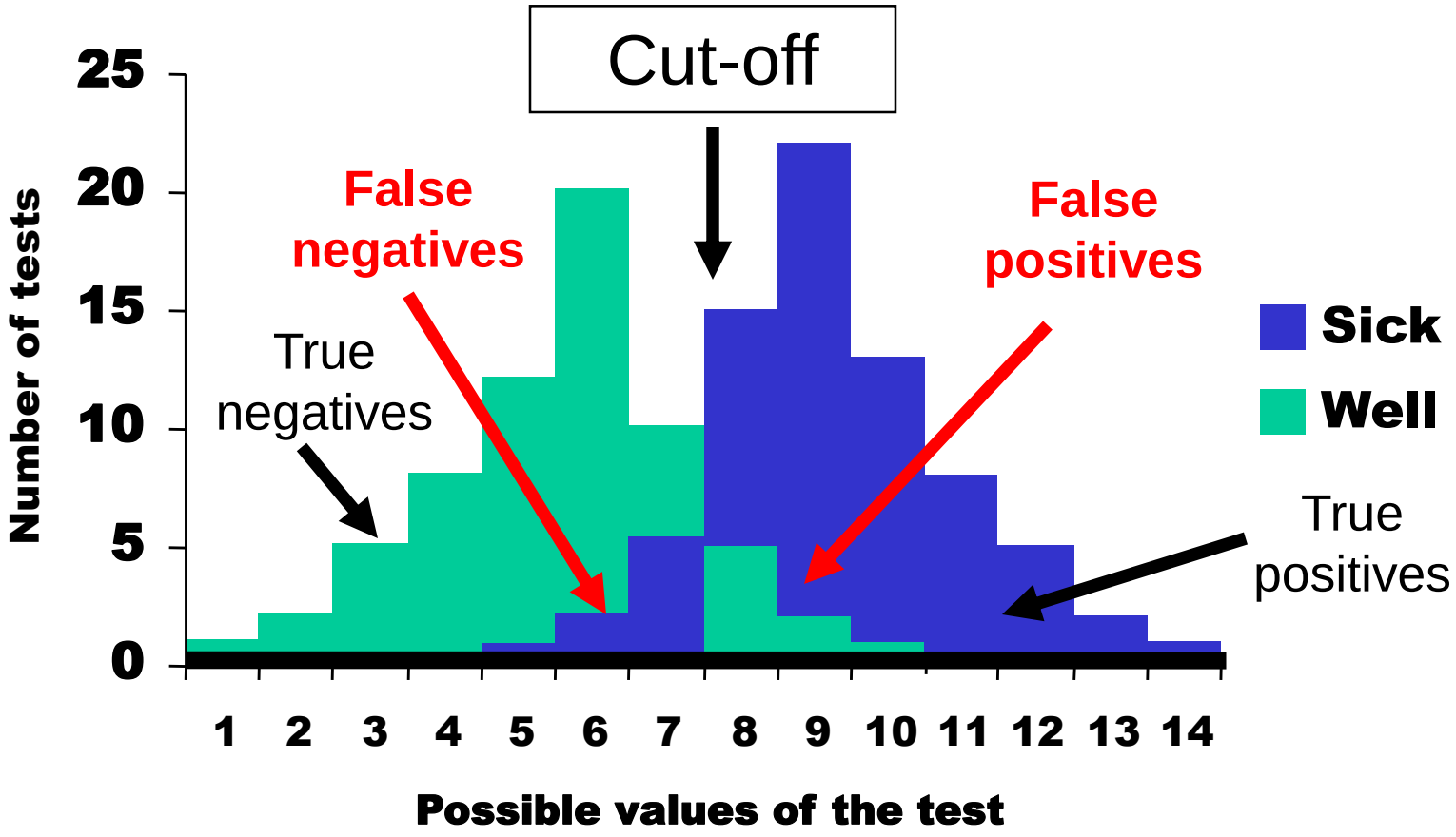
In practice, we choose a cutpoint above which we consider the test to be abnormal and below
which we consider the test to be normal.

- The position of the cut point will determine the
number of true positive, true negatives, false

Identifying the cut-off to use with a test on the basis of panel analysis: Ideal case



Identifying the cut-off to use with a test on the basis of panel analysis: Real case



Which of the two qualities (sensitivity or specificity) is more important in screening?

If the disease is very lethal (e.g., cervical cancer, breast cancer) and early detection markedly improves prognosis, a greater degree of sensitivity, even at the expense of specificity, is desired.

If the disease is prevalent like diabetes for which treatment does not markedly alter outcome, specificity must be high and early cases may be missed, but false positives should be limited; otherwise the health system will be overburdened with diagnostic demands on the positives, both true and false. High specificity is necessary as false positive errors must be avoided.

Positive predictive value:

It is the probability of the person having the disease when the test is positive.

$$\text{Positive predictive value} = \frac{\text{True positive (a)}}{\text{True positive (a)} + \text{False Positive (b)}}$$

Negative predictive value:

It's the probability of the person not having the disease when the test is negative.

$$\text{Negative predictive value} = \frac{\text{True negative (d)}}{\text{True negative (d)} + \text{False negative (c)}}$$

Predictive value of a positive test

The predictive value of a positive test is the probability that an individual testing positive is truly affected

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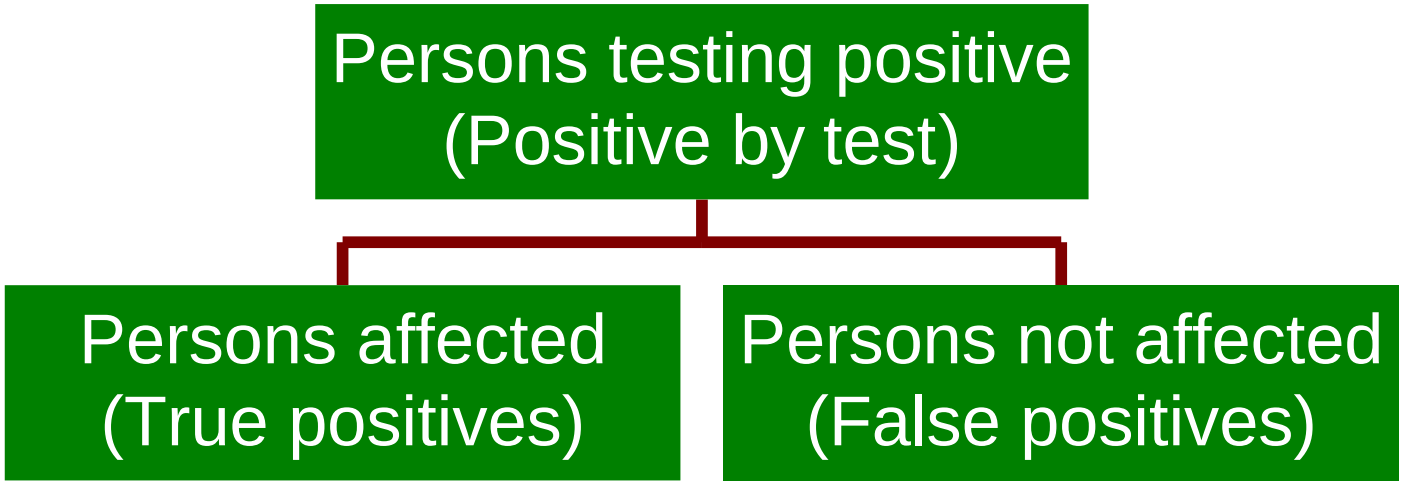
Proportion of affected persons among those testing positive



Predictive value of a positive test =
True positives / Persons testing positive
Estimate the 95% confidence interval

Predictive value of a positive test

		Status of persons		
		Affected	Non-affected	
Test	Positive	A	B	A+B
	Negative	C	D	C+D
		A + C	B+D	A+C+B+D

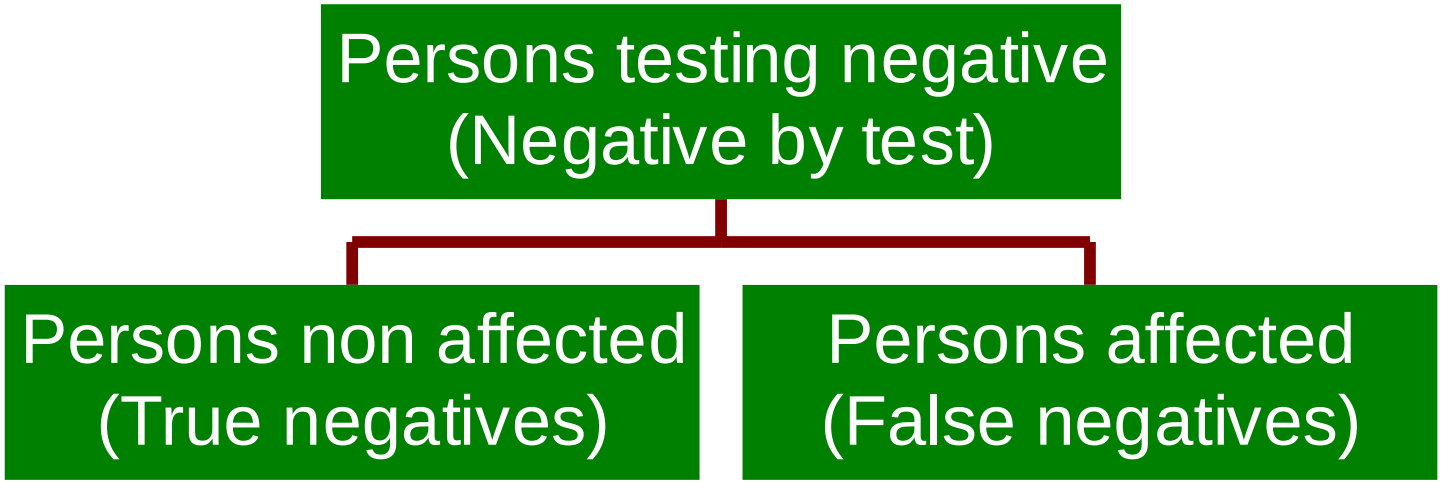
PVP = A / (A+B)

This is only valid for the sample of specimens tested

Predictive value of a negative test

The predictive value of a negative test is the probability that an individual testing negative is truly non-affected

Proportion of non-affected persons among those testing negative



Predictive value of a negative test =
True negatives / Persons testing negative
Estimate the 95% confidence interval

Predictive value of a negative test

		Status of persons		
		Affected	Non-affected	
Test	Positive	A	B	A+B
	Negative	C	D	C+D
		A + C	B+D	A+C+B+D

PVN = D / (C+D)

This is only valid for the sample of specimens tested

Prevalence:-

$$\text{Prevalence} = \frac{\text{total number of cases } (a+c)}{\text{grand total } (a+b+C+d)}$$

Accuracy

$$(a+d)/ (a+b+c+d)$$

Drawback of Screening

- **Stress, anxiety caused by a false positive result**
- **Unnecessary investigation and treatment of false positive results**
- **Prolonging knowledge of an illness if nothing can be done about it**
- **A false sense of security caused by false negatives, which may even delay final diagnosis**
- **Overuse/waste of medical resources**
- **Unnecessary and uncomfortable procedures looking for a disease that is unlikely**

The End

Thank You