

Faculty of medical laboratory science
public health MLS-PUBH-322
sem.6

SCREENING

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Definition:

- The **presumptive identification** of unrecognized disease or defect by the application of tests, examinations or other procedures that can be applied **rapidly**.
- To sort out **apparently well persons** who probably have a disease from those who probably do not.
- Not intended to be diagnostic.
- A positive finding or suspicious finding must be referred for diagnosis



SCREENING

AIMS OF A SCREENING PROGRAMME:

- To detect disease predisposition so that individual can be removed from exposure to specific hazards.

(screening for risk factors i.e. high blood pressure, high serum cholesterol)

- To detect early stages of disease so that treatment can be given.

(screening for disease e.g breast cancer)



CHARACTERISTICS OF SCREENING TESTS

- Validity (Accuracy) of the test
 - Ability of a measuring instrument to give a true measure
- Reliability (Precision)
 - The ability of a measuring instrument to give consistent results on repeated trials.
- Acceptability



VALIDITY

- Should measure the true measurement
- Must give a good indication of those who have the disease



VALIDITY OF THE TEST



The extent to which the test is capable of **correctly diagnosing** the presence or absence of the disease concerned.



TESTING VALIDITY

Measurement is expressed as:

- **SENSITIVITY**

- Is the proportion of diseases people who were correctly identified by the test.

- **SPECIFICITY**

- Is the proportion of non-diseases people who are correctly identified negative by the test.



TESTING VALIDITY

Disease Status (Truth)

		Disease Status (Truth)		
		Yes	No	Total
Screening test result	Positive	a	b	a + b
	Negative	c	d	c + d
	Total	a + c	b + d	a + b + c + d



TESTING VALIDITY

SENSITIVITY

- Is the proportion of diseases people who were correctly identified by the test.
- Frequency with which persons who have the disease test positive

$$a / a + c$$

= those that test positive / all with disease



TESTING VALIDITY

SPECIFICITY

- Is the proportion of non-diseases people who are correctly identified negative by the test.
- Is the frequency with which persons who do not have the disease test negative

$$d / b + d$$

= those that test negative / all without disease



Assume a population of 1000 of whom 100 have the disease and 900 do not have the disease.

Screening test to identify the 100 people with the Disease

**True characteristics
in the population**

		Disease	No disease	
Results Screening Test	Positive	80	100	180
	Negative	20	800	820
		100	900	

Calculate the sensitivity and specificity of the test



ANSWER:

True characteristics
in the population

		Disease	No disease	
Screening Test	Positive	80	100	180
	Negative	20	800	820
		100	900	

$$\text{Sensitivity} = 80/100 \\ = 80\%$$

$$\text{Specificity} = 800/900 \\ = 89\%$$



INTERPRETATION

- Sensitivity 80%
- Specificity 89%
- The screening was good at picking out those without disease but missed 20% of patient who have the disease



COMPARISON OF THE RESULTS OF A TEST WITH ACTUAL DISEASE STATUS

POPULATION

WITH DISEASE

WITH NO DISEASE

POSITIVE

**Have disease & have positive test
= true positive (TP)**

**No disease but have positive test
= false positive (FP)**

NEGATIVE

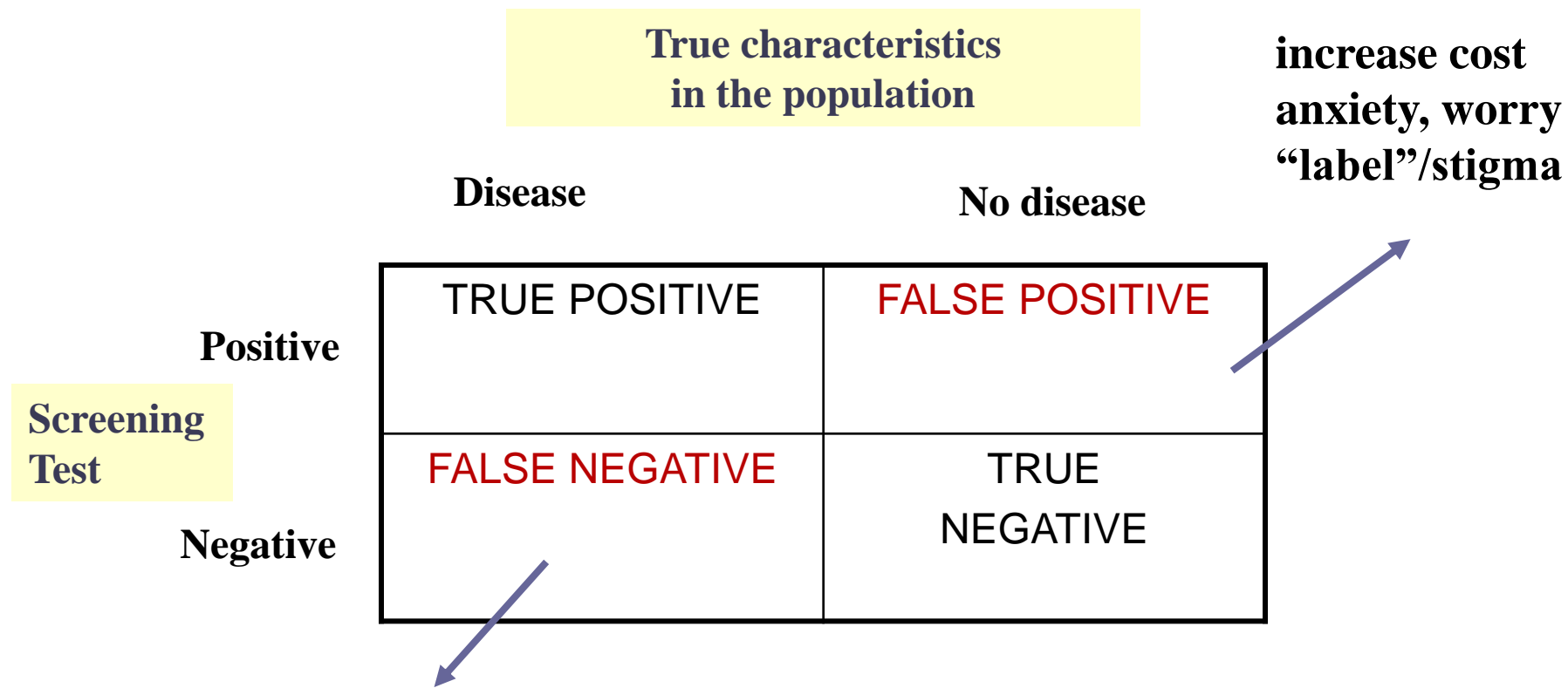
**Have disease but have negative test
= false negative (FN)**

**No disease and have negative test
= true negative (TN)**

$$\text{SENSITIVITY} = \text{TP} / (\text{TP} + \text{FN})$$

$$\text{SPECIFICITY} = \text{TN} / (\text{TN} + \text{FP})$$

VALIDITY OF SCREENING TEST



**Disease is serious
effective intervention is available**

Disease can spread

Subsequent diagnostic evaluation has minimal cost & risk



PREDICTIVE VALUE OF A TEST

- Public health importance : how good is the test at identifying people with disease & without disease (validity of the test)
- Clinical setting : physician would like to knowif the test is positive in this patient what is the probability that this patient has the disease?



PREDICTIVE VALUE OF A TEST

- If the test results are positive in this patient, what is the probability that this patient has the disease?
- **Positive predictive value**
 - What proportion of the patients test positive actually have the disease?
 - A high positive PV - indicated good cost benefit.
- **Negative predictive value**
 - What proportion of the patients test negative do not have the disease?



PREDICTIVE VALUE

Disease Status (Truth)

		Disease Status (Truth)		
		Yes	No	Total
Screening test result	Positive	a	b	a + b
	Negative	c	d	c + d
	Total	a + c	b + d	a + b + c + d



PREDICTIVE VALUE

Predictive value of a positive test (PV+) = $\frac{a}{a + b}$ = Number who test positive with disease/ Number with positive result

Predictive value of a negative test (PV-) = $\frac{d}{c + d}$ = Number who test negative without disease/ Number with negative result



PREDICTIVE VALUE

Test result	Disease	No disease	Total
Positive	80	100	180
Negative	20	800	820
Total	100	900	1000

Calculate a) Positive Predictive Value
b) Negative Predictive Value

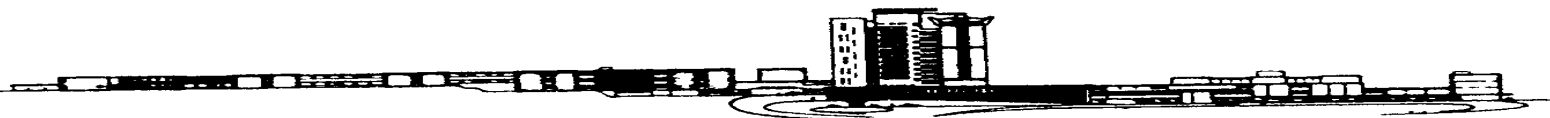


PREDICTIVE VALUE

Test result	Disease	No disease	Total
Positive	80	100	180
Negative	20	800	820
Total	100	900	1000

Positive Predictive Value = $80/180 = 44\%$

Negative Predictive Value = $800/820 = 98\%$



PREDICTIVE VALUE

- Every test that a physician carries out i.e history, physical examination, lab investigations & other procedures – is used to enhance a physician's ability to make a correct diagnosis.
- After administering a test to a patient he wants to knowgiven the positive result, what is the likelihood that the patient has the disease.



PREDICTIVE VALUE & DISEASE PREVALENCE

Disease Prevalence 1%

	Yes	No	Total
Positive	99	495	594
Negative	1	9405	9406
Total	100	9900	10000

$$PV_{+} = 99 / 594 = 17\%$$

Disease Prevalence 5%

	Yes	No	Total
Positive	495	475	970
Negative	5	9025	9303
Total	500	9500	10000

$$PV_{+} = 495 / 970 = 51\%$$

Sensitivity = 99%, Specificity = 95%



PREDICTIVE VALUE & SPECIFICITY

	Yes	No	Total
Positive	180	400	580
Negative	20	400	420
Total	200	800	1000

Prevalence = 20%

Sensitivity = 90%

Specificity = 50%

PV+ = $180/580 = 31\%$

	Yes	No	Total
Positive	100	80	180
Negative	100	720	820
Total	200	800	1000

Prevalence = 20%

Sensitivity = 50%

Specificity = 90%

PV+ = $100/180 = 56\%$



The Wilson-Junger Criteria

- Disease requirements
- Screening test requirements
- Health care system requirements



Disease requirements

- The condition being screened for should be an **important health problem**.
- There should be an **accepted treatment for patients with recognized disease**, and **early treatment should be of more benefit than later treatment**.
- There should be a **detectable preclinical phase (DPCP) of disease**.



Disease requirements

- The **natural history of the condition, including development from asymptomatic to symptomatic disease**, should be adequately understood.



Health care system requirements

- There should be an agreed policy on whom to treat
- The costs of screening (including diagnosis and treatment of patients diagnosed) should be economically balanced against the benefits.
- Screening should be a continuing process, not something that is carried out only once, and appropriate intervals for repeating the test should be determined.



Screening test requirements

- Acceptability
- Precision = reproducibility = reliability = repeatability :
 - *Observer variations
 - *Biological variations
 - *Technical methods
- Validity = accuracy



Advantages

- reduction in mortality attributable to the disease in question
- improved prognosis for some individuals
- less radical treatment
- reassurance of negative test results
- possibly reduced treatment costs.



Disadvantages

- longer duration of morbidity for cases where early detection does not affect the prognosis
- over-treatment of early abnormalities for some individuals who would not have experienced progressive disease
- anxiety generated by false positive test results, and possible morbidity from unnecessary extra investigation of false positive results
- false reassurance given by false negative test results



Thank You

