

CHAPTER 4

DISEASE SCREENING

Screening is the search for **unrecognized disease** or defect by means of rapidly applied tests, examinations or other procedures in apparently healthy individuals.

Validity of a test is the ability to differentiate accurately between those who have the disease and those who do not have.

An important way to view diagnostic and screening tests is through sensitivity analysis. The definitions of relevant terms and symbols are as follows:

T^+ means positive test, T^- means negative test, D^+ means having disease, D^- means not having disease.

Diagnostic test result	True Condition (Presence of Disease)		Total
	Yes(D^+)	No(D^-)	
Positive (T^+)	a	b	a+b
Negative (T^-)	c	d	c+d
Total	a+c	b+d	a+b+ c+d

Sensitivity and Specificity of a screening test

Sensitivity - is the ability of a test to identify correctly those who have the disease. The proportion of diseased persons the test classifies as positive.

$$\text{Sensitivity} = \frac{a}{a+c} = P(T^+/D^+), \text{ (Probability of positive test, given disease)}$$

Specificity - is the ability of a test to identify correctly those who do not have the disease. The proportion of nondiseased persons the test classifies as negative.

$$\text{Specificity} = \frac{d}{b+d} = P(T^-/D^-), \text{ (Probability of negative test, given no disease)}$$

False Positive Rate (FPR): the proportion of nondiseased persons the test classifies (incorrectly) as positive.

$$FPR = \frac{b}{b+d} = P(T^+/D^-); \text{ (probability of positive test, given nodisease)}$$

False Negative Rate (FNR): the proportion of diseased people the test classifies (incorrectly) as negative.

$$FNR = \frac{c}{a+c} = P(T^-/D^+); \text{ (probability of negative test given disease)}$$

Predictive value: is the ability of a test to predict the presence or absence of disease from test results.

Predictive Value of a Positive Test (PVPT): the proportion of positive tests that identify diseased persons.

$$PVPT = \frac{a}{a+b} = P(D^+/T^+); \text{ (Probability of no disease given positive test)}$$

Predictive Value of a Negative Test (PVNT): the proportion of negative tests that correctly identify nondiseased people.

$$PVNT = \frac{d}{c+d} = P(D^-/T^-); \text{ (probability of no disease given negative test)}$$

Accuracy of the Test: is the proportion of all tests that are correct classifications

$$Accuracy = \frac{a + b}{a + c + d + b}$$

Likelihood Ratio of Positive Test: is the ratio of probability of a positive test, given the disease, to the probability of a positive test, given no disease

$$LRPT = \frac{P(T^+/D^+)}{P(T^+/D^-)} = \frac{Sensitivity}{False Positive Rate} = \frac{Sensitivity}{1-Specificity}, \text{ The positive test, given disease versus positive test, given no disease.}$$

Likelihood Ratio of Negative Test: is the ratio of probability of a negative test, given the disease, to the probability of a negative test, given no disease.

$$LRNT = \frac{P(T^-/D^+)}{P(T^-/D^-)} = \frac{False Negative Rate}{Specificity} = \frac{1-Sensitivity}{Specificity}; \text{ The negative test, given disease versus negative test, given no disease}$$

Example: The following table shows the screening test of individuals for cognitive heart failure.

Test Result	Disease status		Total
	Yes (+)	No (-)	
Positive	95	495	590
Negative	5	9405	9410
	100	9900	10000

Compute and interpret sensitivity, specificity, FPR, FNR, PVPT, PVNT, accuracy, LRPT and LRNT.