

Screening Tutorial

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Lead time and lead time bias

- <https://www.youtube.com/watch?v=ngHB1DzP5xc>
- 4:06 – 6:40

Components of Validity

TABLE 3-A
Screening test result by diagnosis

Screening test results	Diagnosis		Total
	Diseased	Not diseased	
Positive	a (True-positive)	b (False-positive)	a + b
Negative	c (False-negative)	d (True-negative)	c + d
Total	a + c	b + d	a + b + c + d

Components of Validity

- Sensitivity = $a / (a+c) \times 100$
- Specificity = $d / (b+d) \times 100$
- predictive value of a positive test = $a / (a+b) \times 100$
- predictive value of a negative test = $d / (c+d) \times 100$
- Percentage of false-negative = $c / (a+c) \times 100$
- Percentage of false-positive = $b / (b+d) \times 100$

Sensitivity

- The ability of the test to identify correctly all those who have the disease, that is “true-positive”.
- 90% sensitivity means that 90% of the diseased people screened by the test will give a “true-positive” result and the remaining 10% a “false-negative” result.

Specificity

- The ability of a test to identify correctly those who do not have the disease, that is “true-negatives”
- 90% specificity means 90% of non-diseased persons will give “true-negative” result, 10% of non-diseased people screened by the test will be wrongly classified as “diseased” when they are not “false-positive”.

Predictive accuracy

- Reflects the diagnostic power of a test.
- Depends upon sensitivity, specificity and disease **prevalence**
- The **probability** that a patient with a positive test result has, in fact, the disease in question.
- The more prevalent is a disease in a given population, the more accurate will be the predictive value of a positive screening test.

Example

Diagnosis of brain tumours by EEG

EEG results	Brain tumour	
	Present	Absent
Positive	36	54,000
Negative	4	306,000
	40	360,000

Sensitivity = $36/40 \times 100 = 90$ per cent

Specificity = $306,000/360,000 \times 100 = 85$ per cent

Diagnosis of brain tumours by computer assisted axial tomography

CAT results	Brain tumour	
	Present	Absent
Positive	39	18,000
Negative	1	342,000
	40	360,000

Sensitivity = $39/40 \times 100 = 97.5$ per cent

Specificity = $342,000/360,000 \times 100 = 95$ per cent

Predictive value of a positive gram-stained cervical smear test
(with constant sensitivity of 50% and specificity of 90%) at three levels of prevalence

	Prevalence 5%			Prevalence 15%			Prevalence 25%				
	Culture		Total	Culture		Total	Culture		Total		
	+	-		+	-		+	-			
Smear	+ 25	95	120	Smear + 75	85	160	Smear + 125	75	200		
	- 25	855	880		- 75	765	840	- 125	675	800	
Total	50	950	1000	Total	150	850	1000	Total	250	750	1000
Positive predictive value	$\frac{25}{120} \times \frac{100}{1} = 21\%$			Positive predictive value	$\frac{75}{160} \times \frac{100}{1} = 47\%$			Positive predictive value	$\frac{125}{200} \times \frac{100}{1} = 63\%$		

Exercise 1:

- In a survey, 100 persons were positive to the **reference** test for disease A and 900 were negative. The **screening** test identified 200 persons to be positive. Of these 80 were positive to the reference test.
1. Calculate sensitivity, specificity, predictive value positive and predictive value negative for screening test.
 2. Calculate percentage of false-positive and false-negative.

In a survey, 100 persons were positive to the **reference** test for disease A and 900 were negative. The **screening** test identified 200 persons to be positive. Of these 80 were positive to the reference test.

		Reference test		
		+ve	-ve	Total
Screening test	+ve	80	120	200
	-ve	20	780	800
	Total	100	900	1000

- **Sensitivity** = $a / (a+c) \times 100$
= $80/100 \times 100 = 80\%$
- **Specificity** = $d / (b+d) \times 100$
= $780/900 \times 100 = 86.7\%$

- **predictive value of a positive test** $=a/(a+b) \times 100$

$$= 80/200 \times 100 = 40\%$$

- **predictive value of a negative test** $=d/(c+d) \times 100$

$$= 780/800 \times 100 = 97.5\%$$

- **Percentage of false-negative** = $c/(a+c) \times 100$
= $20/100 \times 100 = 20\%$
- **Percentage of false-positive** = $b/(b+d) \times 100$
= $120/900 \times 100 = 13.3\%$

Exercise 2:

- A new non invasive test has been developed to diagnose breast cancer. Of 1000 patients; 50% were diagnosed positive. Of those who tested positive, a Biopsy test yielded 475 with positive results. Of those who tested negative; 50 patients were actually Cancer breast positive when tested against the Biopsy.
- 1. Calculate sensitivity, specificity, predictive value positive and predictive value negative for screening test.**
 - 2. Calculate percentage of false-positive and false-negative.**

Create the 2x2 table

		diagnostic test		
		Breast cancer +	No breast cancer -	Total
Screening test	+ve	475	25	500
	-ve	50	450	500
	Total	525	475	1000

Sensitivity=90.5%

Specificity=94.7%

PPV=95%

NPV=90%

PF-ve=9.5%

PF+ve=

Exercise 3:

In a survey, 100 persons were positive to the **reference** test for disease A and 900 were negative. The **screening** test identified 200 persons to be positive. Of these 80 were positive to the reference test.

- 1. Calculate sensitivity, specificity, predictive value positive and predictive value negative for screening test.**
- 2. Calculate percentage of false-positive and false-negative**

		diagnostic test		
		+ve	-ve	Total
Screening test	+ve	80	120	200
	-ve	20	780	800
	Total	100	900	1000

Sensitivity=

NPV=

Specificity=

PF-ve=

PPV=

PF+ve=

Exercise 4:

- Match the following sentences with the appropriate term:

(sensitivity, specificity, PP+ve, PP-ve)

1. The ability of a test to correctly identify those who have a disease.
2. The proportion of those with the disease identified as negative by screening test.
3. Ability of the test to detect true negative cases.
4. Probability of disease in patients with positive test result.
5. Probability of not having the disease in a subject with negative test result.

Exercise 5:

300 known diabetics (positive on the glucose tolerance test) and 250 normal volunteers (negative on the glucose tolerance test) are given finger prick tests, the results are:

		Glucose tolerance test		
		+	-	Total
Finger Prick	+	282	20	302
	-	18	230	248
	Total	300	250	

1- Sensitivity of the test is:

- a) 20%
- b) 90%
- c) 94%
- d) 98%

2- Specificity of the test is

- a) 90%
- b) 92%
- c) 94%
- d) 98%

3- The capacity of a test or procedure to screen as “negative” those NOT having a specific disease is

- a) sensitivity
- b) specificity
- c) positive predictive value
- d) negative predictive value

Any Question?