# TUTORIAL: SCREENING

# PERFORMANCE OBJECTIVES

Compute and interpret

- Sensitivity
- Specificity
- Predictive value positive
- Predictive value negative
- False positive rate
- False negative rate

"Screening is defined as the search for unrecognized disease or defect by means of rapidly applied tools in apparently healthy individuals not seeking medical care"

| Screening test results | Gold standard | | Total |
|---|---|---|---|
| | Diseased | Not diseased | |
| Positive | a<br>True positive | b<br>False positive | a+b |
| Negative | c<br>False negative | d<br>True negative | c+d |
| Total | a+c | b+d | a+b+c+d |

Sensitivity is ability of the test to detect correctly those who truly have the condition (true positive) $= \frac{a}{a+c}$

Specificity is ability of the test to detect correctly those who truly don't have the condition (true negative) $= \frac{d}{b+d}$

| Screening test results | Gold standard | | Total |
|---|---|---|---|
| | Diseased | Not diseased | |
| Positive | a<br>True positive | b<br>False positive | a+b |
| Negative | c<br>False negative | d<br>True negative | c+d |
| Total | a+c | b+d | a+b+c+d |

$$\text{False negative rate} = \frac{c}{a+c}$$

$$\text{False positive rate} = \frac{b}{b+d}$$

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Predictive value positive ($Pv_{+ve}$) is the probability that a person positive by the test truly have the condition $= \frac{a}{a+b}$

Predictive value positive ($Pv_{-ve}$) is the probability that a person negative by the test truly don't have the condition $= \frac{d}{c+d}$

# SCREENING: EXERCISES

| Test (ELISA) | Hepatitis C (RIBA) | | Total |
|---|---|---|---|
| | Positive | Negative | |
| Positive | | | |
| Negative | | | |
| Total | | | |

A total of 100 barbers were screened for hepatitis C using ELISA followed by confirmation of the diagnosis using RIBA. Results shows that 57 out of the 59 positive by the ELISA were as well positive by the RIBA and 38 out of the 41 negative by the test were as well negative by the RIBA.

Present the data in a suitable table

EXERCISE -1

| Test (ELISA) | Hepatitis C (RIBA) | | Total |
|---|---|---|---|
| | Positive | Negative | |
| Positive | 57 | 2 | 59 |
| Negative | 3 | 38 | 41 |
| Total | 60 | 40 | 100 |

A total of 100 barbers were screened for hepatitis C using ELISA followed by confirmation of the diagnosis using RIBA. Results shows that 57 out of the 59 positive by the ELISA were as well positive by the RIBA and 38 out of the 41 negative by the test were as well negative by the RIBA.

Identify the true positive, true negative, false positive and false negative cell

EXERCISE -1

| Test (ELISA) | Hepatitis C (RIBA) | | Total |
|---|---|---|---|
| | Positive | Negative | |
| Positive | 57 (TP) | 2 (FP) | 59 |
| Negative | 3 (FN) | 38 (TN) | 41 |
| Total | 60 | 40 | 100 |

A total of 100 barbers were screened for hepatitis C using ELISA followed by confirmation of the diagnosis using RIBA. Results shows that 57 out of the 59 positive by the ELISA were as well positive by the RIBA and 38 out of the 41 negative by the test were as well negative by the RIBA.

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|---|---|---|---|
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| Total | 60 | 40 | 100 |

Sensitivity

Specificity

False positive

False negative

Pv+ve

Pv-ve

A total of 100 barbers were screened for hepatitis C using ELISA followed by confirmation of the diagnosis using RIBA. Results shows that *57* out of the *59* positive by the ELISA were as well positive by the RIBA and 38 out of the *41* negative by the test were as well negative by the RIBA.

Calculate and interpret the sensitivity, specificity, predictive values and errors of the ELISA

# EXERCISE -1

| Test (ELISA) | Hepatitis C (RIBA) | | Total |
|---|---|---|---|
| | Positive | Negative | |
| Positive | 57 (TP) | 2 (FP) | 59 |
| Negative | 3 (FN) | 38 (TN) | 41 |
| Total | 60 | 40 | 100 |

Calculation of the sensitivity, specificity, predictive values and errors of the ELISA

| | |
|---|---|
| Sensitivity | (57/60)x 100 = 95% |
| Specificity | (38/40) x 100 = 95% |
| False positive | (2/40) x 100= 5% |
| False negative | (3/60) x 100= 5% |
| Pv+ve | (57/59) x 100= 98.3% |
| Pv-ve | (38/41) x 100= 92.7% |

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Sensitivity:

The test was able to identify correctly 95% of those who have anti-bodies (indicate previous exposure) against hepatitis C virus

Specificity:

The test was able to identify correctly 95% of those who don't have anti-bodies (indicate no previous exposure) against hepatitis C virus

Both sensitivity and specificity of the ELISA are high values

EXERCISE -1

| Test (ELISA) | Hepatitis C (RIBA) | | Total |
|---|---|---|---|
| | Positive | Negative | |
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| Negative | 3 (FN) | 38 (TN) | 41 |
| Total | 60 | 40 | 100 |

Sensitivity (57/60)x 100 = 95%
Specificity (38/40) x 100 = 95%
False positive (2/40) x 100= 5%
False negative (3/60) x 100= 5%
Pv+ve (57/59) x 100= 98.3%
Pv-ve (38/41) x 100= 92.7%

EXERCISE -1

False positive rate

It is the complementary of the specificity

The test misclassified 5% of the subjects as positive; they are in fact negative

False negative rate

It is the complementary of the sensitivity

The test misclassified 5% of the subjects as negative; they are in fact positive

| Test (ELISA) | Hepatitis C (RIBA) | | Total |
|---|---|---|---|
| | Positive | Negative | |
| Positive | 57 (TP) | 2 (FP) | 59 |
| Negative | 3 (FN) | 38 (TN) | 41 |
| Total | 60 | 40 | 100 |

| | |
|---|---|
| Sensitivity | (57/60)x 100 = 95% |
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| Pv-ve | (38/41) x 100= 92.7% |

Predictive value positive

Out of those who were positive by the ELISA, 98.3% were positive by the confirmatory test

Predictive value negative

Out of those who were negative by the ELISA, 92.7% were negative by the confirmatory test

The test has a high yield

EXERCISE -1

| Ck results | Myocardial infarction | | Total |
|---|---|---|---|
| | Positive | Negative | |
| Positive ≥ 80 IU | 215 | 16 | 231 |
| Negative < 80 IU | 15 | 114 | 129 |
| Total | 230 | 130 | 360 |

Sensitivity
Specificity
False positive
False negative
Pv+ve
Pv-ve

A study was conducted to evaluate the role of serum creatine kinase (CK) in the identification of acute myocardial infarction (MI) among 360 patients admitted to the ICU with suggestive symptoms. Results are presented in the opposite table.

Compute and interpret the sensitivity, specificity, predictive values and false rates obtained by the test.

EXERCISE -2

| Ck results | Myocardial infarction | | Total |
|---|---|---|---|
| | Positive | Negative | |
| Positive ≥ 80 IU | 215 | 16 | 231 |
| Negative < 80 IU | 15 | 114 | 129 |
| Total | 230 | 130 | 360 |

Sensitivity (215/230) x 100= 93.5%
Specificity (114/130) x 100=87.7%
False positive (16/130) x 100=12.3%
False negative (15/230) x100= 6.5%
Pv+ve (215/231) x 100=93.1%
Pv-ve (114/129) x100= 88.4%

## EXERCISE -2

The test is suitable for screening because its high sensitivity and predictive value positive

The test is capable to identify correctly 93.5% of those with MI and 93.1% of those positive by the test have MI.

Its specificity and predictive value negative are still good but lower than sensitivity and predictive value positive as CK may be elevated in association with other conditions.

Those who receive false reassurance are only 6.5% of those tested negative by the test

| Bleeding | Uterine cancer | | Total |
|---|---|---|---|
| | Positive | Negative | |
| Positive | 10 | 40 | 50 |
| Negative | 5 | 45 | 50 |
| Total | 15 | 85 | 100 |

Sensitivity
Specificity
False positive
False negative
Pv+ve
Pv-ve

The opposite table portrays the results of confirmation of the diagnosis of uterine cancer among 50 women who presented with bleeding and 50% who did not report bleeding.

Compute and interpret the sensitivity, specificity, predictive values and false rates obtained by the test.

EXERCISE -3

| Bleeding | Uterine cancer | | Total |
|---|---|---|---|
| | Positive | Negative | |
| Positive | 10 | 40 | 50 |
| Negative | 5 | 45 | 50 |
| Total | 15 | 85 | 100 |

Sensitivity (10/15) x 100 = 66.7%
Specificity (45/85) x 100 = 77.5%
False positive (40/85) x 100 = 47.1%
False negative (5/15) x 100 = 33.3%
Pv+ve (10/50) x 100 =20%
Pv-ve (45/50) x 100= 90%

Bleeding has a low specificity and much lower sensitivity in indicating the presence of uterine cancer.

Its false positive rate means that nearly 50% of the women will be subjected to a series of investigation at high cost and they will be negative

Like wise, 33.3% of the women who are not presenting with bleeding will receive a false reassurance that they are free

On the contrary, the absence of bleeding means a high probability (0.90) that they are free from uterine cancer

## EXERCISE -3