Screening
L2

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Learning Objectives

- Define screening, principles, types, screening tests and criteria.
- Analysis of screening and the terms used to evaluate screening test validity … by sensitivity, specificity, PPV, NPV …..

Suppose a new blood test is used to screen 1,000 children for leukemia. After follow-up diagnostic testing, the results are:

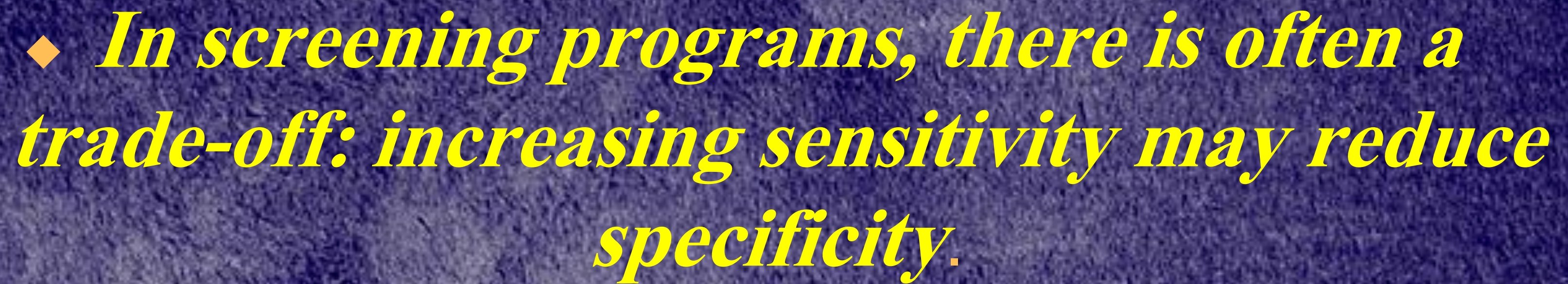
New test	Gold standard test for Leukemia		Total
	Positive	Negative	
(+)ve	40(a)	60(b)	100 (a+b)
(-)ve	10(c)	890(d)	900(c+d)
Total	50 (a + c)	950 (b + d)	1000 a+b+c+d

Sensitivity:

It is :a/ (a + c) x100 = 40/ (10 + 40) = 80 %. 80% of all those with leukemia are successfully identified by new test.

Specificity:

it is : d/ (b + d)x100 = 890/ (890 + 60)= 93.7%. 93.7% of all those without leukemia are picked up by new test as negative.


In screening programs, there is often a trade-off: increasing sensitivity may reduce specificity.

- What is the probability that a person with a test result +ve do really have leukemia?

PPV

- What is the probability that a person with a test result -ve do really not have leukemia?

NPV

PREDECTIVE VALUES :-

They are the ability of the test to uncover those who really have (or have not) disease among all those with a positive (or negative) screening test results.

Positive predicative value :

It is probability (%) that individual with a positive test result, realy has the disease .

$$\text{Positive predicative value (PPV)} = \frac{\text{True positive}}{\text{All those with positive test results}} \times 100$$

It is the proportion of the true +ve individuals among all those with a positive test result.

Negative predicative value (NPV):

$$(NPV) = \frac{\text{True Negative}}{\text{All those with negative test results}} \times 100$$

- It is also probability (%) that an individual with negative test result, really doesn't have the disease .
- It is the proportion (%) of the true negative test among all those with a negative test result.

New test	Gold standard test for Leukemia		Total
	Positive	Negative	
(+)ve	40(a)	60(b)	100 (a+b)
(-)ve	10(c)	890(d)	900(c+d)
Total	50 (a + c)	950 (b + d)	1000 a+b+c+d

The positive predictive value of a test

It is : a / (a + b)x100 = 400 / (40 + 60) = 40%

- ✓ 40% of those who are positive by new test are likely to have Leukemia.

The negative predictive value of a test

It is :d / (c + d)x100 = 890 /(900)= 98.9%

- ✓ 98.9% of those who are new test negative are likely to be not leukemic.

PPV tell us how proportion of test +ve are true +ve and if this % is higher as close to 100 as possible then it suggest that this new test is doing as good as “gold standard”..

NPV tells us how proportion of test -ve are true -ve and if this % is higher (should be close to 100), then it suggests that this new test is doing as good as “gold standard”.

- What can affect the PPV?
- Prevalence of the disease.

Sensitivity = 99%; Specificity = 95% ; pop= 10,000

Prevalence = 1%	Disease Yes	Disease No	PPV
Positive result	99	495	594
Negative result	1	9405	
Total	100	9900	17%
Prevalence = 5%			
Positive result	495	475	970
Negative result	5	9025	
Total	500	9500	51%

- **Higher the prevalence of the disease, greater the (+)predictive values.**
- **Low prevalence, will lower the PPV, even a test with high Se & Sp.**

- ***So … As a general rule, screening is most beneficial and economical when focusing on:***

- ***High risk group or In a population with high disease prevalence.***

- **The more sensitive the test, the better its NPV.**
- **The more specific the test, the better its PPV.**

Group (a) True +ve	Group (b) False +ve
Group (c) False -ve	Group (d) True -ve

- **Most useful result of a highly sensitive test is when it is**

  Negative.

- **Most useful result of a highly specific test is when it is**

  Positive

Group (a) True +ve	Group (b) False +ve
Group (c) False -ve	Group (d) True -ve

Cutoffs

- Used for a test do not yield obvious –ve and +ve results but continues No. that required the cutoff point to distinguish +ve and –ve.
- The cutoff is threshold above which a test is considered positive.
  - Total cholesterol of 200mg/dL separates borderline from desirable total cholesterol.
- The specificity and sensitivity of a test are strongly influenced by the value of the cutoff!

- HOW CAN YOU INCREASE THE SENSIVITY OF A TEST?

  if Lower the positive threshold for defining a positive result. → overdiagnosis, costly …

- HOW CAN YOU INCREASE THE SPECIFICITY OF A TEST?

  Raise the positive threshold

Uses of a sensitive test:

1- High sensitivity is crucial to catch most cases (low frequency of a disease in screening process).

2- when there is a harmful effect of false negative results, (as: contagious conditions) e.g. missing a case of meningitis as a case of flue like disease. is fatal in emergency clinics.

3- To rule out differential diagnoses e.g. D-dimer test is used to rule out a suspected PE case.(if negative we are sure there is no PE)

4- For life-threatening or high-risk condition.

Uses of a specific test:

1- when there is a harmful effect of false positive results emotionally and financially to a person, e.g. wrong HIV diagnosis.

2- To rule in differential diagnoses e.g. endoscopy after barium meal to rule in gastric cancer. (if positive confirms the diagnosis).

3- Mostly useful in non-emergency situations.

Notes:

- **Screening test should neither miss high cases (false reassurance), nor should it falsely classify healthy people as diseased. (missed diagnosis)**
- **It is important that all new tests should be validated by comparison against a gold standard test.**
- **The tests are generally not 100% accurate. If the sensitivity is very high, the specificity tends to be low.**
- **An ideal test of 100% sensitivity and 100% specificity does not exist.**

Summary

- Screening is the process of identifying unrecognized disease or risk factors in asymptomatic individuals using tests, exams, or procedures.
- • Goal: Early detection to improve outcomes….
- Ultimately, a test is considered valid when its sensitivity and specificity are balanced (relatively high)
- The optimal balance between Sp &Sn depends on the costs of false negatives (missed cases) versus false positives (unnecessary follow-up).

Sp rules IN (positive result confirms disease)

Sn rules OUT (negative result excludes disease)