UNIVERSITY MEDICINE • EXERCISE SHEET

12.4 Diagnostic tests

Name: _____ Class: _____ Date: _____ **Total: 24 marks**

KEY WORDS sensitivity • specificity • likelihood ratio

Objective

Move fluently between the 2×2, the tree and the LR.

1 Key knowledge and worked examples

■ **Columns vs rows**

Se = a/(a+c), Sp = d/(b+d) – columns; PPV = a/(a+b), NPV = d/(c+d) – rows that move with prevalence ✓. LR+ = Se/(1−Sp) travels.

■ **Worked example: one test, two clinics**

Se = Sp = 90 %: at 10 % prevalence PPV = 90/180 = 50 %; at 1 %, PPV = 9/108 = 8.3 % ✓ – the same test, different truth.

2 Practice

2.1 Which cell pair defines sensitivity? [3]

2.2 Se 90 %, Sp 80 % – LR+? [3]

2.3 Why does NPV rise as prevalence falls? [3]

3 Exam-style questions

3.1 A synthetic new test evaluated against a reference standard: among 200 diseased, 160 test positive; among 800 healthy, 120 test positive.

Compute Se (160/200 = 80 %), Sp (680/800 = 85 %) and LR+ (0.80/0.15 ≈ 5.3) ✓. Then build the natural-frequency tree for this test at a clinic prevalence of 25 % among 1,000 people and compute the PPV and NPV ✓. [8]

3.2 The same test is used in a low-prevalence screen (2 %).

Predict the direction of PPV (falls sharply) and NPV (rises toward its ceiling) and explain both with the tree (false positives scale with the healthy majority) ✓. State one consequence for a screening programme (most positives are false; confirmatory testing required) ✓. [7]

Solutions

2.1

- a and c: TP among the diseased – a/(a+c) ✓.

2.2

- LR+ = 0.90/0.20 = 4.5 ✓.

2.3

- Fewer diseased → fewer false negatives; the negatives are nearly all truly well ✓.

3.1

- Se = 160/200 = 80 %; Sp = 680/800 = 85 % ✓.
- LR+ = 0.80/(1−0.85) = 5.3 ✓.
- At 25 %: 250 diseased → 200 TP, 50 FN; 750 healthy → 112.5 FP, 637.5 TN ✓.
- PPV = 200/312.5 = 64 %; NPV = 637.5/687.5 = 92.7 % ✓.

3.2

- PPV falls: at 2 %, 20 diseased → 16 TP; 980 healthy → 147 FP → PPV = 16/163 ≈ 9.8 % ✓.
- NPV rises: false negatives shrink with the diseased minority → NPV ≈ 833/837 ≈ 99.5 % ✓.
- Programme consequence: most screen positives are false – a confirmatory (more specific) test is needed ✓.

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