Deacon's Challenge No. 64 Answer

An endomysial antibody assay has been reported to have a diagnostic sensitivity of 88% and a diagnostic specificity of 97% for coeliac disease. What is the probability that a positive result truly indicates coeliac disease in a group of subjects whose pre-test probability of coeliac disease is 1 in 1500?

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Let TP = true positives, FP = false positives
TN = true negatives, FN = false negatives

Sensitivity is the percentage of patients with disease that are identified by the test:

$$\text{Sensitivity (\%)} = \frac{TP \times 100}{(TP + FN)} = 88\%$$

Specificity is the percentage of patients without disease who are identified by the test as not having the disease:

$$\text{Specificity (\%)} = \frac{TN \times 100}{TN + FP} = 97\%$$

The probability of a positive result truly indicating coeliac disease is the positive predictive value of the test PV(+):

$$PV(+) = \frac{TP}{TP + FP}$$

Therefore, all that is required is to determine values for TP and FP and substitute into this expression.

Since the incidence of coeliac disease in the population is 1 in 1500, we can write:

Number (or rather proportion) with coeliac disease
$(TP + FN) = 1$
Number (or rather proportion) without coeliac disease
$(TN + FP) = 1500 - 1 = 1499$

TP is calculated from sensitivity and the proportion of patients with coeliac disease:

$$\frac{TP \times 100}{1} = 88 \quad \text{therefore} \quad TP = \frac{88}{100} = 0.88$$

TN is calculated from specificity and the proportion of patients without coeliac disease:

$$\frac{TN \times 100}{1499} = 97 \quad \text{therefore} \quad TN = \frac{97 \times 1499}{100} = 1454$$

Since $(TN + FP) = 1499$, $FP = 1499 - TN = 1499 - 1454 = 45$

Therefore $PV(+) = \frac{0.88}{(0.88 + 45)} = \frac{0.88}{45.88} =$ **0.019** (2 sig figs)

or, the probability is 1 in 1/0.019 = **1 in 53** (2 sig figs) ■

Question 65

The pKa of acetic acid is 4.76. What volume of 0.2 mmol/L acetic acid should be added to 80 mL 0.2 mmol/L sodium acetate to give a buffer with a pH of 5.8. Comment on the buffer capacity of this buffer.

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