Deacon's Challenge

No 188 - Answer

The table shows data for two urinary screening tests for the detection of phaeochromocytoma:

Test	*Sensitivity (%)*	*Specificity (%)*
VMA	*96.7*	*99.1*
Total metanephrines	*100*	*98*

The prevalence of phaeochromocytoma in a hypertensive population is known to be 0.5%.

For a hypertensive individual calculate the probability of phaeochromocytoma being present:

a) Before either test is performed
b) If the VMA test is positive
c) If the total metanephrine test is positive

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a) The pre-test probability of disease is simply the prevalence expressed as an absolute value i.e. 0.005

b) The probability of a positive test result indicating the presence of disease is simply the ratio of true positives (TP) to all positive results (TP + FP):

$$\text{Probability of disease if result positive} = \frac{TP}{TP + FP}$$

Values for TP and FP can be calculated from sensitivity, specificity and prevalence. For simplicity it is probably easiest to work with a hypothetical large population e.g. 1,000,000

For a population of 1,000,000 the prevalence becomes 1,000,000 x 0.5/100 = 5,000

Since 96.7% (the sensitivity) of these individuals will give a positive VMA test

$$TP = 5{,}000 \times 96.7/100 = 4{,}835$$

For a population of 1,000,000 the number without disease is 1,000,000 - 5,000 = 995,000 and since the specificity (the percentage of these disease-free individuals giving a negative result) is 99.1%

$$TN = 995{,}000 \times 99.1/100 = 986{,}045$$

And the remainder will have positive (FP) results = 995,000 - 986,045 = 8,995

Therefore probability of phaeochromocytoma if VMA is positive $= \frac{TP}{(TP + FP)}$

$$\frac{4{,}835}{(4835 + 8995)} = \frac{4{,}835}{13{,}830} = \mathbf{0.35} \text{ (to 2 sig figs)}$$

c) Similarly for the total metanephrine test:

$$TP = 5{,}000 \times 100/100 = 5{,}000$$

$$TN = 995{,}000 \times 98/100 = 975{,}100$$

$$FP = 995{,}000 - 975{,}100 = 19{,}900$$

Probability of phaeochromocytoma if total metanephrine test is positive

$$= \frac{5{,}000}{(5{,}000 + 19{,}900)} = \frac{5{,}000}{24{,}900} = \mathbf{0.20} \text{ (to 2 sig figs)}$$

Question 189

A 44-year old woman, who suffered a miscarriage of pregnancy four days previously, was found to have a serum β-HCG concentration of 658 IU/L. Given that the half-life of β-HCG at more than 48-hours after termination of pregnancy is 56 hours, in how many days time would you expect her serum β-HCG concentration to reach a level of 5 IU/L?

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