Deacon's Challenge

No 123 - Answer

A screening programme for Down's syndrome has a screen positive rate of 4% and a detection rate of 85%. Calculate the probability that a pregnancy judged to be at low risk will result in an affected child, given that the incidence of Down's syndrome at term is 1.84/1000 births in the absence of selective abortion. State any assumptions made.

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Let TP = true positives = proportion of all results which are positive in Down's pregnancies

FP = false positives = proportion of all results which are positive in normal pregnancies

TN = true negatives = proportion of all results which are negative in normal pregnancies

FN = false negatives = proportion of all results which are negative in Down's pregnancies

Solution of this problem requires knowledge of TN and FN. Values can be determined from the information given:

Incidence of Down's at term = TP + FN = 1.84/1000 = 0.00184

The detection rate is the proportion of Down's pregnancies detected by the test = 85% = sensitivity

$$\text{Sensitivity (\%)} = \frac{TP \times 100}{(TP + FN)} = 85\%$$

Substitute (TP + FN) = 0.00184 and solve for TP:

$$\frac{TP \times 100}{0.00184} = 85$$

$$TP = \frac{0.00184 \times 85}{100} = 0.001564$$

and $FN = (TP + FN) - TP = 0.00184 - 0.001564 = 0.000276$

The screen positive rate (4%) is the percentage of all results which are positive. The remainder (96%) must be negative and will constitute both true and false negatives.

Therefore TN + FN = 96% (or 0.96 as a proportion).

The probability of a pregnancy judged to be at low risk (negative result) actually having Down's is the proportion of negative results that are false negatives:

Probability of Down's with a negative result =

$$\frac{FN}{(TN + FN)} = \frac{0.000276}{0.96} = \mathbf{0.0002875\ (i.e.\ 1\ in\ 3478)}$$

Question 124

A man admitted with nausea and confusion was found to have a serum sodium concentration of 107 mmol/L. Calculate the volume of 1.8% sodium chloride anticipated to raise his serum sodium to 125 mmol/L, and the rate of infusion expected to achieve a rate of increase of 0.5 mmol/hour (atomic masses: Na 23, Cl 35.5).

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