Deacon's Challenge
No 114 - Answer

100 serum samples from healthy individuals were analysed in order to determine a reference range for a new analyte. The data were found to be significantly skewed so a logarithmic transformation was used to derive a 95% confidence interval of 20-100 nmol/L. What is the probability of obtaining a value of 116 nmol/L or greater from a normal subject? Values of the normal deviate (z-score) and P are:

P(%)	10	5	2	1	0.2	0.1
z	1.65	1.96	2.32	2.58	3.09	3.29

Since the data are skewed the first step is to convert the reference range to logarithms then calculate the mean and standard deviation in logarithmic units:

$$\log_{10} 20 \quad = \quad 1.301$$

$$\log_{10} 100 \quad = \quad 2.000$$

The 95% confidence limits cover the mean $\pm 1.96SD$ i.e. spans $2 \times 1.96 = 3.92$ *SDs*

Therefore $\log_{10}SD = \dfrac{2.000 - 1.301}{3.92} = 0.178$

The *mean* is the average of the upper and lower limits:

$$\log_{10}Mean = \dfrac{2.000 + 1.301}{2} = 1.651$$

(N.B. logarithms do not have units)

Finally calculate the *z*-score for 116 nmol/L – remembering to first convert it to a logarithm:

$$\log_{10} 116 \quad = \quad 2.064$$

$$z = \dfrac{2.064 - Mean}{SD} = \dfrac{2.064 - 1.651}{0.178} = \dfrac{0.413}{0.178} = 2.32$$

A *z*-score of 2.32 corresponds to a probability of 2% i.e. a value of greater than 2.32*SD* or less than -2.32*SD* will be obtained on two occasions out of every 100 assays of specimens from normal subjects. Therefore one half of this, i.e. 1% of results will be greater than 2.32*SD* above the mean (corresponding to the analyte concentration of 116 nmol/L).

Therefore probability of obtaining a value of greater than 116 nmol/L from a normal individual = **1% (i.e. 0.01).**

Question 115

Calculate the measured plasma sodium concentration if blood with a true plasma sodium concentration of 140 mmol/L is mistakenly drawn into an 'anticoagulation' Vacutainer tube.

These tubes originally contain 0.5 mL trisodium citrate solution (citrate concentration 0.105 mol/L) and the final volume of anticoagulated blood is 4.5 mL. You may assume that the sodium measurement is analytically correct.

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