

Deacon's Challenge

No 126 - Answer

Calculate the range of the 95% confidence limits for the total cholesterol:HDL-cholesterol ratio calculated from the following data:

Total cholesterol = 5.4 mmol/L Analytical CV = 2.0%
HDL-cholesterol = 1.2 mmol/L Analytical CV = 2.5%

The rules for obtaining combined standard deviations when two independent variables (x and y with standard deviations s_x and s_y) are multiplied or divided are:

$$\begin{aligned} 1. \quad s_{xy} &= xy \{ \sqrt{s_x^2/x^2 + s_y^2/y^2} \} \\ 2. \quad s_{x/y} &= x/y \{ \sqrt{s_x^2/x^2 + s_y^2/y^2} \} \end{aligned}$$

Note that, unlike when variables are added or subtracted, the values for the variables themselves are included in the calculation.

First calculate the standard deviations for each analyte from their CVs and concentrations:

$$\text{Standard deviation} = \frac{\text{Concentration} \times \text{CV} (\%)}{100}$$

$$s_{\text{Total chol}} = \frac{5.4 \times 2.0}{100} = 0.108 \text{ mmol/L}$$

$$s_{\text{HDL-cho}} = \frac{1.2 \times 2.5}{100} = 0.030 \text{ mmol/L}$$

Substitute these, together with values for x and y, into equation 2:

$$\begin{aligned} s_{\text{Total chol/HDL-cho}} &= \text{Total chol/HDL-cho} \{ \sqrt{s_{\text{Total chol}}^2/\text{Total chol}^2 + s_{\text{HDL-cho}}^2/\text{HDL-cho}^2} \} \\ &= 5.4/1.2 \{ \sqrt{(0.108^2/5.4^2 + 0.030^2/1.2^2)} \} \\ &= 4.5 \{ \sqrt{(0.01166/29.16 + 0.0009/1.44)} \} \\ &= 4.5 \{ \sqrt{(0.0003998 + 0.000625)} \} \\ &= 4.5 \{ \sqrt{0.001025} \} \\ &= 4.5 \times 0.0320 \\ &= 0.144 \end{aligned}$$

The 95% confidence limits include the mean $\pm 1.96s$ so encompasses a range of $2 \times 1.96 \times s$

Therefore 95% range = $2 \times 1.96 \times 0.144 = 0.56$ (to 2 sig figs)

No units since the analyte (cholesterol) and units (mmol/L) of each component are the same and cancel.

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Question 127

A patient after returning from holiday presents to his GP with a set of laboratory results obtained during a brief hospital admission in the USA. The GP asks you to convert the following data to "SI units" commonly used in the UK:

Plasma glucose = 270 mg/dL
Plasma creatinine = 2.3 mg/dL
Plasma BUN = 50 mg/dL

Urine albumin:creatinine ratio = 40 mg/g

(Molecular weights: glucose = 180, creatinine = 113)

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