Appendix S1

Formulae used in the construction of the CUSUM chart (20).

General CUSUM formula:

$$S_n = \sum (X_i - s)$$

where, is a score calculated from the probabilities of "success" (p_0) and probabilities of "failure" (p_1):

$$s = \frac{\ln((1 - p_0)/(1 - p_1))}{\ln(\frac{1 - p_0}{1 - p_1}) + \ln(\frac{p_1}{p_0})}$$

Decision limits (h_1) and (h_0) are graphical boundaries that determine if a process is in or out of control and are calculated based on:

- α: risk of type I error
- β: risk of type II error

$$h_1 = \frac{\ln\frac{1 - \beta}{\alpha}}{\ln\left(\frac{1 - p_0}{1 - p_1}\right) + \ln\left(\frac{p_1}{p_0}\right)}$$

$$h_0 = \frac{\ln\frac{(1 - \alpha)}{\beta}}{\ln\left(\frac{1 - p_0}{1 - p_1}\right) + \ln(\frac{p_1}{p_0})}$$