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Erratum

Erratum to "From exposure to effect: a comparison of modeling approaches to chemical carcinogenesis" [Mutat. Res. 489 (2001) 17–45]☆

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The publisher regrets that in the above paper a number of typographical errors occurred in the formulae of Box 3. In addition to this a further error occurred in the last paragraph on page 23 of the paper. These errors are corrected below.

Box 3. Multi-stage models
Let N_0 denote the number of susceptible normal cells (stem cells) and J the random variable 'time until a certain cell gives rise to a tumor cell'. The probability that an organism is tumor free at time t equals the probability that not any cell transforms into a tumor cell before time t. Under the assumption that cells transform independently of each other, this implies that $G_T(t)$ equals the product of N_0 times $\mathrm{G}_J(t)$ or, equivalently, $G_T(t) = G_J(t)^{N_0} = \{1 - F_J(t)\}^{N_0}$. In terms of the hazard rates this means $h_T(t) = N_0 h_J(t)$.
Exact formula: If two changes are required to transform a certain cell, the time to transformation equals the sum of the waiting time until the first change (K_1) and the waiting time between the first and the second change (K_2). The variables K_1 and K_2 follow an exponential distribution with parameters p_1 and p_2, respectively. F'_J can be expressed in terms of F'_{K_1} and F'_{K_2}, as follows: $F'_J(t) = \int_0^t F'_{K_1}(s) F'_{K_2}(t-s)\,\mathrm{d}s = p_1 p_2 \{\mathrm{e}^{-p_1 t} - \mathrm{e}^{-p_2 t}\}/(p_2 - p_1)$. Integration gives an exact expression for F_J and, thus, also for $G_T = \{1 - F_J\}^{N_0}$.
Approximate formula: From Eq. (3), we have $G'_J(t) = -h_J(t) G_J(t)$. Because of the relation $F_J = 1 - G_J$, this is equivalent to $F'_J(t) = h_J(t)\{1 - F_J(t)\}$. In this context, the assumption that transformation is a rare phenomenon means $(1 - F_J) \approx 1$ or equivalently, $h_J(t) \approx F'_J(t)$. The hazard for T then yields: $h_T(t) = N_0 h_J(t) \approx N_0 F'_J(t) = p_1 p_2 N_0 \{\mathrm{e}^{-p_1 t} - \mathrm{e}^{-p_2 t}\}/(p_2 - p_1)$. Based on expansion in Taylor series about $t = 0$ and the assumption that p_1 and p_2 are small, this expression reduces to: $h_T(t) \approx p_1 p_2 N_0 t$. Thus, for the two stage model $\mu = p_1 p_2 N_0$ (Eq. (9)).

The equation on the second line of the last paragraph on page 23 should read as follows:

$$C'(t) = \frac{Q'(t)}{V}$$

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