MODELING OF THE DEPENDENCE OF MEDIAN EFFECTIVE DOSE ON DOSE RATE

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Based on many studies, in animals and humans, on the effects of radiation at various dose rates, Jones et al. [1986] and later Scott with co-authors [Scott et al., 1988] proposed their models on the dependence of the median effective dose D_{50} on dose rate.

The model of Jones is a power-function type, with two positive parameters a and b:

$$D_{50} = a \cdot R^{-b}, \qquad (1)$$

where R is dose rate.

Scott's model also includes two positive parameters:

$$D_{50} = \theta_1 \cdot R^{-1} + \theta_\infty. \qquad (2)$$

The presence, in this case, of a horizontal asymptote (θ_∞), is completely valid from biophysical point of view. This relationship, together with the Weibull risk model served as a basis for recommendations of the UK National Radiological Protection Board [NRPB, 1996] and also was utilized in our recent work [Scott et al, 1998].

In this work we present a new generalized model which takes into account the presence of horizontal asymptote and introduces reference values R* and D*:

$$\frac{D_{50} - \theta_\infty}{D^*_{50} - \theta_\infty} = \left(\frac{R}{R^*} \right)^{-\beta}, \qquad (3)$$

where β is a positive parameter.

It should be underscored that this formula presents a corresponding solution to a differential equation with an initial condition.

The proposed model is expected to more fully account for the characteristics of biophysical processes that take place in an irradiated population or a biological system.

In conclusion we point out that when $\beta=1$, this model coincides with Scott's model and when $\theta_\infty = 0$, with the model of Jones.

References

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