AbstractID: 5190 Title: On the equivalency of the population and individual TCP models

Purpose:
To demonstrate that the functional form of the population tumor control probability (TCP) model is well approximated by the individual TCP model.

Method and Materials:
Due to inter-parameter relations, the parameters of the population based Poisson TCP model in the limit of large heterogeneity reduce to the geometric parameters D_{50} and γ_{50}:[1] $TCP_{pop}=0.5erfc[\pi^{0.5}\gamma_{50}(D_{50}/D - 1)]$. On the other hand the individual TCP model can also be written in the terms of the geometrical characteristics of the dose-response relationship - D_{50} and γ_{50}: $TCP_{ind}=0.5\exp[2\gamma_{50}/(\ln 2)(1-D/D_{50})] = \exp[-N_o \exp(-\alpha D)]$. For typical clinical values[2] of the parameters D_{50} and γ_{50}, we evaluate and compare the individual and population-based TCP models.

Results:
The two models are approximately equivalent for different values of D_{50} and γ_{50}. When plotted, the individual and population-based TCP models almost overlap over a wide range of doses for all D_{50} values and γ_{50} higher than 1. When γ_{50} is less than 1 both functions start to differ from one another.

Conclusion:
The equivalency between the individual and population TCP models is demonstrated. The individual TCP model has been observed to fit clinical datasets reasonably well, and this phenomenon may be attributed to the similarity of the models. When fitted to clinical data, the individual TCP model will produce parameter estimates completely emptied from their biological meaning and become purely phenomenological.

1. M. Carlone, B. Warkentin, P. Stavrev, and B. G. Fallone. "Fundamental form of the population TCP model in the limit of large heterogeneity,", submitted to Med Phys, 2006.
2. P. Okunieff, D. Morgan, A. Niemierko, and H. D. Suit. "Radiation dose-response of human tumors," Int J Radiat Oncol Biol Phys 1995. 32(4): p. 1227-37.