The Effect of Age Structure on Stem and Non-stem Cancer Cell Population Dynamics

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The Cancer Stem Cell Hypothesis says that there are two types of cancer cells, stem and non-stem, and that the stem cells are those which initiate and drive tumor growth and have unlimited proliferation capacity. Cancer stem cells can give rise to mortal non-stem cancer cells with unknown but limited proliferation potential. We use a system of ordinary differential equations to conduct mathematical and numerical investigations of the dynamics of the interactions of these two populations. First, we built linear multi-compartment ODE models and found their analytic and steady-state solutions and performed sensitivity analyses. The sizes of the stem and non-stem populations were compared to see the effect of accounting for generational age. A 2-compartment model capturing the multi-component results was also built. Next, a nonlinear model took into account competition for resources by using proliferation rates that decline as the cell population rises.