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Mathematical Modeling of Senescent Cells in Cancer Treatment

Cancer is a complex disease, the progression of which depends on interactions between tumor cells and their environment. Among the mechanisms involved, cellular senescence, which leads to a permanent halt in cell proliferation, has long been recognized for its protective role against cancer. However, studies have revealed that senescent cells can also promote tumor progression and limit the efficacy of treatments, notably by altering the immune response. What if these two effects were to coexist, and certain unexpected treatment combinations could allow us to harness senescent cells to our advantage, rather than suffering from their harmful effects?

These cells secrete molecules that can support the tumor, but they can also facilitate the action of therapeutic treatments. These molecules are known as the SASP (senescence-associated secretory phenotype), and it is this duality that we aim to understand using a mathematical model.

To gain further insight, we are developing an ordinary differential equation (ODE) model that describes the interactions between senescent cells, tumor cells, the immune system, and blood vessels. Calibrated using experimental data from mice, this model will enable us to explore the efficacy of various therapeutic combinations, depending on the specific biological context.