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Global Dynamics of A Model of Joint Hormone Treatment with Dendritic Cell Vaccine for Prostate Cancer

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Hormone therapy, in the form of androgen deprivation therapy, is often used to treat advanced prostate cancer. This treatment is initially effective, but often gives rise to castration-resistant prostate cancer, which is often fatal. One suggested therapy, in order to mitigate unpleasant side effects and delay resistance to treatment, is intermittent androgen deprivation therapy, wherein the patient is placed on or off treatment depending on their prostate specific antigen (PSA) levels, a biomarker of the disease. When patients advance to castration-resistant prostate cancer, they may be given immunotherapy in the form of dendritic cell vaccines, which has been proven effective in clinical trials. We propose a 6D ordinary differential equation model describing the combination of androgen deprivation therapy (continual and intermittent) with dendritic cell vaccines. We use simulations to determine sensitivities in the model with regards to scheduling the administration of therapy. We also perform basic local stability analysis to determine a personalized dendritic cell vaccine dosage that results in local disease-free stability. Finally, we let several quantities approach quasi-steady state and perform full analysis, including global stability, of the limiting model to determine biological conditions that result in global stability of cancer-free equilibrium.