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Modeling the Hypothalamic Pituitary Adrenal Axis System for Dexamethasone Treatment

The hypothalamic pituitary adrenal axis (HPA) system regulates stress in the brain. When this system experiences a dysfunction, such as during chemotherapy treatments, there can be a number of unwanted side-effects such as depression or chronic fatigue syndrome. Dexamethasone (Dex) is a pharmaceutical drug used to lessen side-effects of some cancer treatments and to prevent some HPA dysfunctions. In this study, we adapt a system of nonlinear ordinary differential equations for the HPA system to account for the administration of Dex. We propose a simplified system which focuses on the hormone and receptors directly affected by Dex. Uncertainty analysis is used to see how changes in parameter values effect the output of both the full and simplified systems as a whole, while sensitivity analysis is used to determine how sensitive the model is to these small parameter changes. Additionally, equilibria for the simplified model are found numerically. In the parameter sets explored, the equilibrium is stable.