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Optimal control in a pharmacokinetics/pharmacodynamics model of doripenum

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Pharmacokinetics (PK) describes a drug's affect on a medium (such as bacteria or tumours) while pharmacodynamics (PD) describes how a drug moves throughout and is processed by the body (along with changes in drug concentration). Taken together, these models are known as PK/PD models and ordinary differential equations (ODE) are used to describe the system. We consider an existing model in the literature of the drug doripenem affect on the bacteria *P. aeruginosa* that considers the count of bacteria and resting bacteria in the central and peripheral compartments of the body. Dosing strategies tend to differ depending on the disease being treated; however, a consistent factor in treatments is an administration of 500mg for one hour, every eight hours. Treatments of this nature tend to reach concentration levels of 50mg/ml, before tapering off. Exceeding the 500mg dose brings increased risk of seizures, among other dangerous side effects including headaches, nausea, diarrhea, rashes, phlebitis, and anemia. We use control theory to search for an optimal dosing strategy and compare the results to that of the standard every-eight-hours administration. Our results show that the amount of drug needed in the control case is considerably less compared to standard dosing and that we can easily find situations in which the same amount of drug administered in the standard way will not kill the bacteria but administered in the optimal manner will kill the bacteria. This has potential significance in the case of immune compromised patients that may not be able to tolerate a standard dosing strategy.

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