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Title: A multi-layer model for transdermal drug delivery: analysis and simulation

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Abstract: Mathematical models for drug delivery are extensively used as a powerful predictive tool for a fundamental understanding of biotransport processes. For example, many studies have been carried out to investigate the release properties of a therapeutic agent from a device across the skin, as in a transdermal patch, or sometimes with the use of an electrical field to enhance the release, as in iontophoresis.

To study these processes, a mathematical model describing the dynamics of a substance between a multi-layer media of different properties and extents is presented. The first layer is the polymeric platform (vehicle) where the drug is initially contained, and the other ones represent the dermal tissue where the drug is directed to. A system of partial differential equations describes the diffusion and the convection induced by the electrical potential.

The typical drug dynamics, the concentration levels, the optimal delivery rate are shown as outcomes of simulations and discussed in some case studies. The results are used to discuss the roles of the different model parameters, to evaluate drug release efficacy and to assess an optimal control strategy in the rational design of advanced delivery systems.