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## **Mathematical Model of Microbicidal Flow Dynamics and Optimization of Rheological Properties for Intra-vaginal Drug Delivery: Role of Tissue Mechanics and Fluid Rheology**

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### **Abstract**

Topically applied microbicide gels can provide a self-administered and effective strategy to prevent sexually transmitted infections (STIs). We have investigated the interplay between vaginal tissue elasticity and the yield-stress of non-Newtonian fluids during microbicide deployment. We have developed a mathematical model of tissue deformation driven spreading of microbicidal gels based on thin film lubrication approximation and demonstrated the effect of tissue elasticity and fluid yield-stress on the spreading dynamics. Our results show that both elasticity of tissue and yield-stress rheology of gel are strong determinants of the coating behavior. An optimization framework has been demonstrated which leverages the flow dynamics of yield-stress fluid during deployment to maximize retention while reaching target coating length for a given tissue elasticity.

### **Keywords**

Microbicide gel, Non-Newtonian fluid, Yield stress, Thin film flow, Numerical optimization, Tissue biomechanics

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