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Integrating Pharmaceutical Processing into Hepatitis Virus Treatment Model: Optimizing Drug Release and Therapeutic Response

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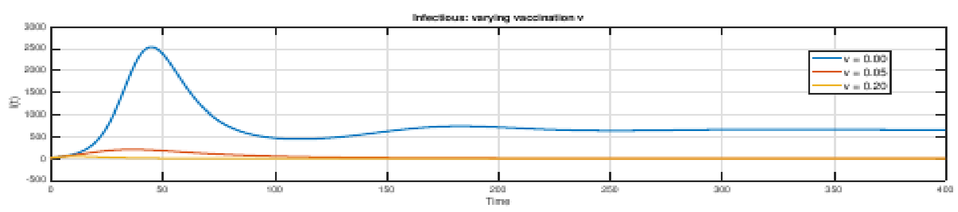
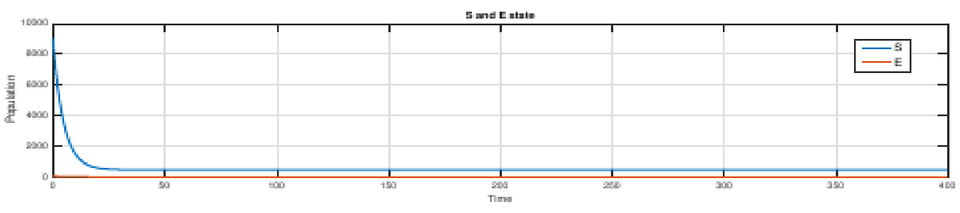
INTRODUCTION & AIM

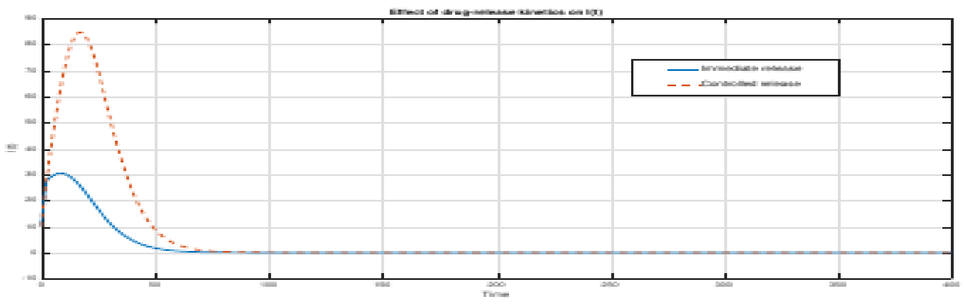
- **Hepatitis virus remains a global health challenge.**
- **This work links pharmaceutical processing with epidemiological modeling.**
- **Objective: Optimize drug release and therapeutic response for hepatitis control.**
- **Integrates vaccination, treatment efficacy, and disease dynamics in one framework.**

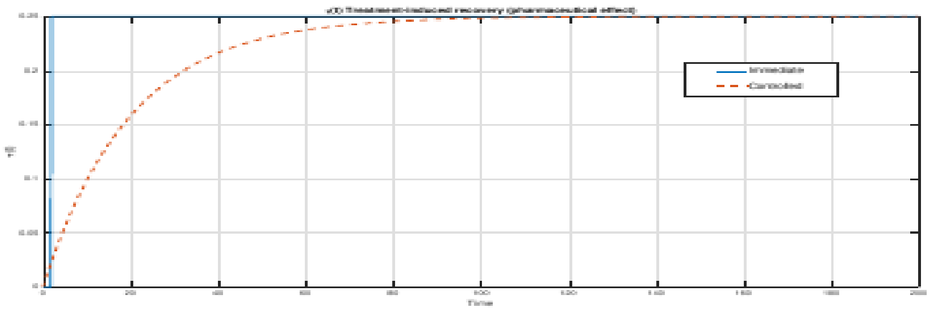
METHOD

- **Model:** SEIR-type system — S(t), E(t), I(t), R(t).
- Linear incidence βSI.
- Key parameters: Λ, β, μ, ν, κ, γ, δ, τ.
- Derived R_0 using Next Generation Matrix method.
- Analyzed equilibrium stability via Jacobian and Routh–Hurwitz criteria.
- Performed sensitivity analysis and MATLAB numerical simulations.







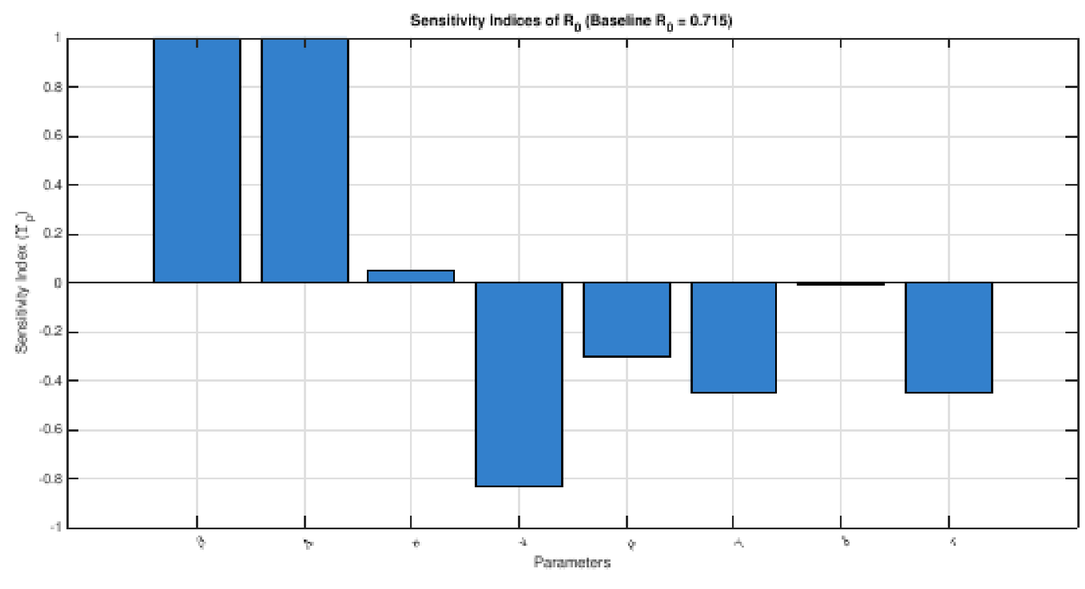


RESULTS & DISCUSSION

- **Stability:** Disease-Free Equilibrium (DFE) is stable if $R_0 < 1$; Endemic Equilibrium (EE) is stable if $R_0 > 1$.
- **Sensitivity:** Transmission rate (β) and recruitment (Λ) have the strongest positive effect on R_0.
- Vaccination (ν), recovery (γ), and treatment (τ) reduce R_0 effectively.
- Simulations show vaccination and immediate drug release minimize infection peaks.
- Controlled drug release delays recovery and increases infection duration.
- Combined vaccination and treatment can push $R_0 < 1$ ensuring eradication.-

CONCLUSION

- Pharmaceutical processing and vaccination work synergistically against hepatitis.
- Immediate-release formulations achieve faster recovery and smaller epidemic peaks.
- Controlled-release formulations prolong infection period.
- Modeling drug kinetics provides insight into optimizing treatment design.



FUTURE WORK / REFERENCES

T. Megala, T. Nandha Gopal, M. Siva Pradeep, et al. Dynamics of re-infection in a Hepatitis B Virus epidemic model with constant vaccination and preventive m00easures. J. Appl. Math. Comput. (2025).

M. Gumus, K. Turk, Dynamical behavior of a hepatitis B epidemic model and its NSFD scheme, J. Appl. Math. Comput.1-22, 2023.