

# Determining temperature dependence of SARS-CoV-2 viral parameters

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## Background

- SARS-CoV-2 replication is influenced by environmental factors, particularly temperature.
- Experimental studies show differences in viral growth at 33 °C and 37 °C.
- Mathematical modeling connects viral load data to biological processes.
- Viral dynamics models describe interactions between uninfected cells, infected cells, and virus particles over time.
- The goal: quantify how temperature affects key kinetic parameters.
- Identifying temperature-sensitive parameters improves understanding of infection dynamics.

## Viral dynamics model

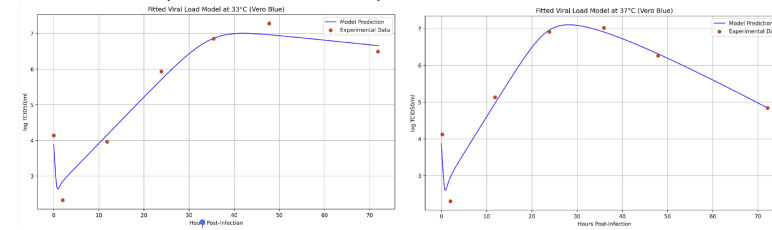
- Target cell-limited model:

$$\begin{aligned}\dot{T} &= -\beta TV \\ \dot{E} &= \beta TV - kE \\ \dot{I} &= kE - \delta I \\ \dot{V} &= pI - cV\end{aligned}$$

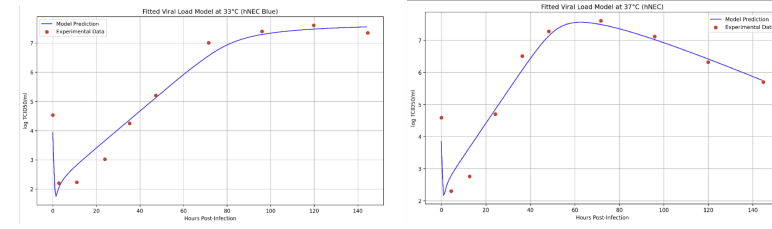
- $T$  = uninfected target cells,  $E$  = eclipse phase,  $I$  = productively infected cells,  $V$  = free virus.
- $\beta$  = infection rate,  $k$  = eclipse phase transition,  $\delta$  = infected cell death,  $p$  = viral production,  $c$  = viral clearance.

## Model fits

Vero E6 (33°C vs 37°C)

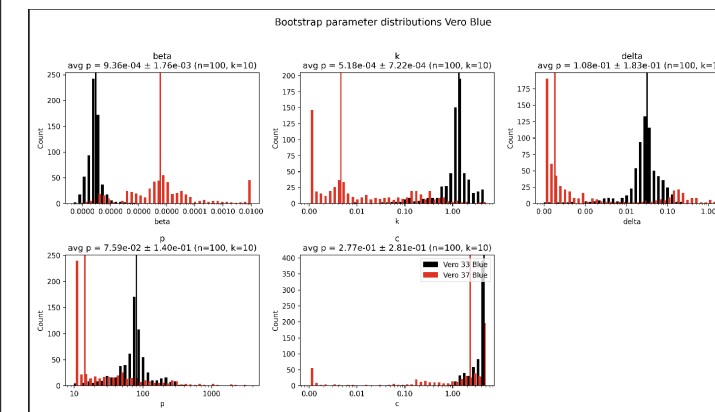


hNEC (33°C vs 37°C)



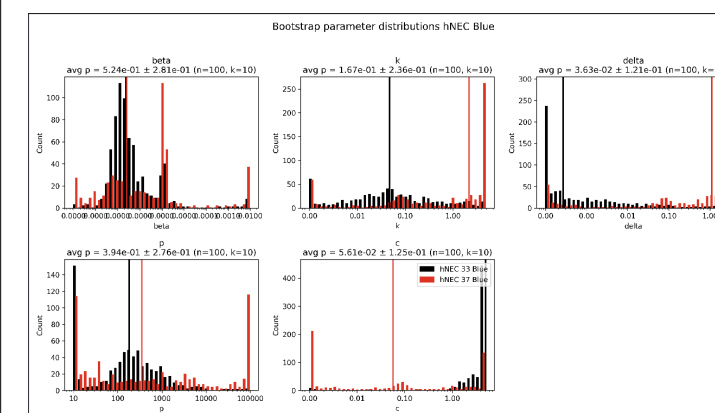
- Lines = model predictions, points = experimental data
- Fits show temperature-dependent dynamics

## Temperature effects in Vero cells



- Infection rate ( $\beta$ ), eclipse rate ( $k$ ), and cell death ( $\delta$ ) vary with temperature
- Indicates strong thermal sensitivity in viral dynamics

## Temperature effects in hNEC cells



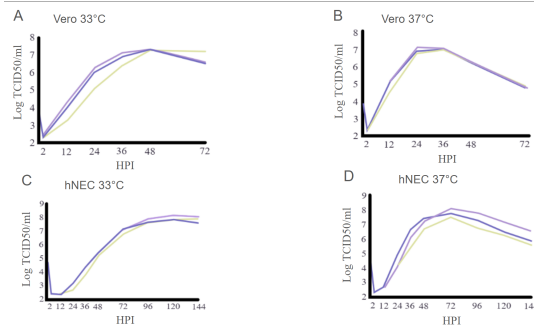
- Parameter distributions largely overlap across temperatures
- Minimal temperature dependence observed

## Conclusions

- SARS-CoV-2 replication dynamics are temperature-dependent in a cell-type specific manner
- Vero E6: strong temperature dependence in  $\beta$ ,  $k$ ,  $\delta$
- hNEC: minimal temperature dependence
- Modeling links experimental data to biological processes

## Viral Load Data

Viral load measurements are obtained from in vitro infection experiments.



These experiments measure infectious viral concentration over time at different temperatures and in different cell types.

## Future directions

- Extend analysis to additional temperatures
- Explore other cell types and viral strains