ReadME

- Latent infection is **assumed** to be treated by ART
- Morphine effects and Pharmacodynamics are varied.
- Dynamics of ART treatment at different stages:
  - Early and Late treatments of the Latent Reservoir and Viral Load dynamics
  - Peak Viral Dynamics of Latent Reservoir and Viral Load.

Parameters:

Morphine Effect

morphine influences affects the Target T cells susceptiblity by changing the expression of the coreptors

- r $\equiv$ morphine transition rate of $T_L \rightarrow T_H$
- q $\equiv$ morphine transition rate of $T_H \rightarrow T_L$

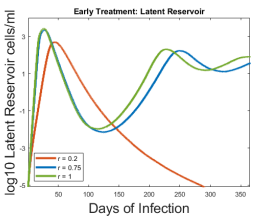
Note: T_L T cells with low susceptibility to infections; T_H T cells with high susceptiblity to infections.

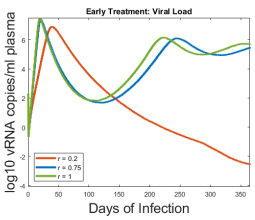
Pharmacodynamics of ART

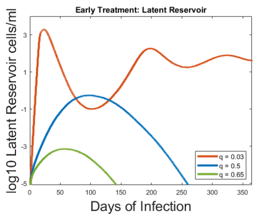
- $m_i \equiv$ drug slope inhibition (of infectivity)
- $n = \frac{D^i_{max}}{ED50} \equiv$ Drug maximum concentration ratio of inhibitory to reach 50% effect
- $t_{\frac{1}{2}} \equiv$ drug half-life
- $\tau \equiv$ drug intake interval

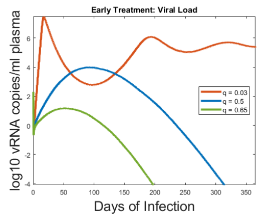
Early Treatment

- ## Morphine Effect



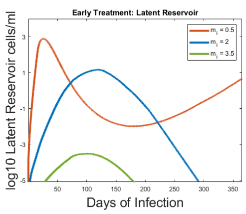


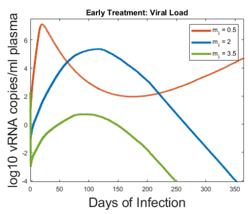


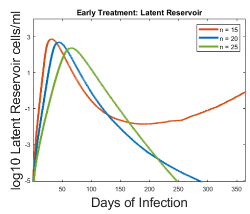


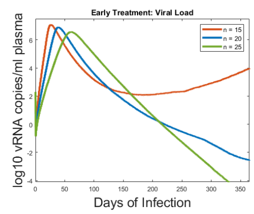
- When low level of morphine is found with $r = 0.2$, the infection is eventually controlled.
- At high level of morphine with $r = 0.75$ and $r = 1$, the infection persists.
- Vice versa is seen in q.

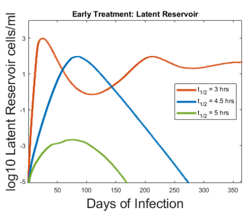
- ## Pharmacodynamic Effect

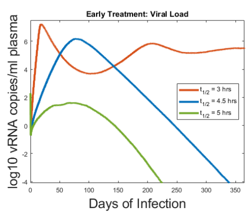


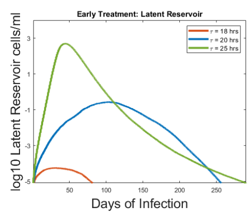


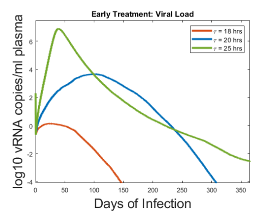








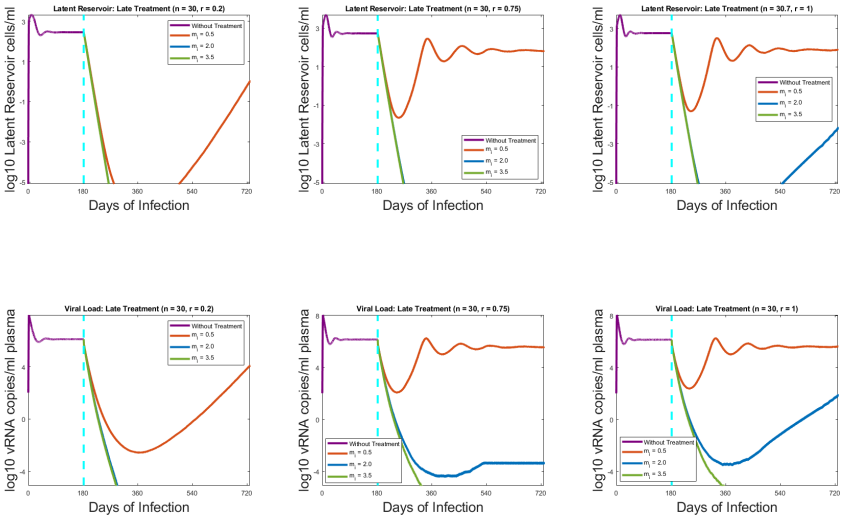




- Through varied Pharmacodynamic parameters for cases: m_i, n, and $t_{\frac{1}{2}}$
  - when $m_i = 0.5$,n = 15, andt_{\frac{1}{2}} = 3$ shows the infection in the latent reservoir and viral load persists.
  - when $m_i = 2; 3.5$, $n = 20; 25$, and $t_{\frac{1}{2}} = 4.5; 5$ shows the infection in the latent reservoir and viral load is controlled.
- For τ, since this is a drug-dosage intake:
  - $\tau = 18; 20$ hours shows the infection is controlled since the drug intervals are not skipped.
  - $\tau = 25$ hours shows the infection persists due to skipped intervals.

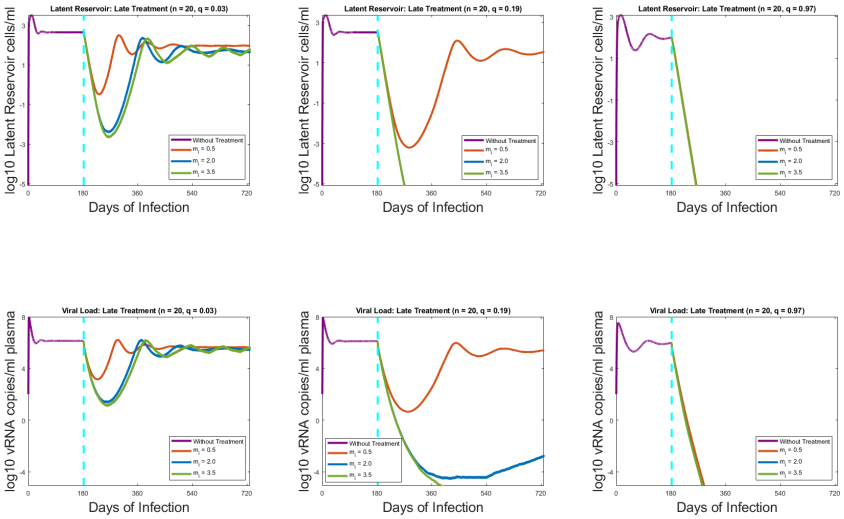
Late Treatment

- ## Morphine Effects (r)



- Morphine transition rate r varied at different morphine levels to show the progression of the HIV infection of m_i at different parameters.
- The higher the r is, the higher m_i needs to be to control HIV infection.

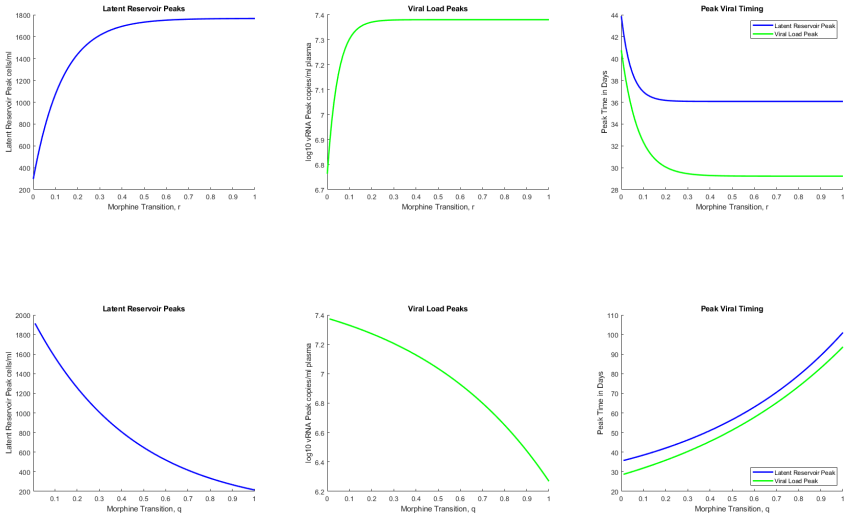
- ## Morphine Effects (q)



- Morphine transition rate q varied at different morphine levels to show the progression of the HIV infection of m_i at different parameters.
- The higher the q is, if $m_i \geq 2$ can control HIV infection.

Peak Viral Dynamics

- ## Morphine Effects



r:

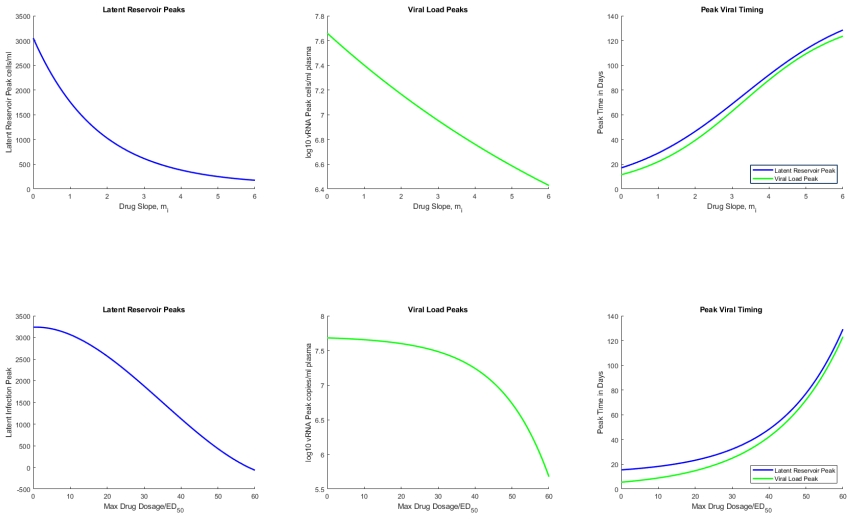
- As r increases, the peaks of the latent reservoir and viral load has a monotonic increasing solution curve.
- The timing to reach peak in r decreases, implying the days to reach viral peaks is quicker.

q:

- As q increases, the peaks of the latent reservoir and viral load has a monotonic decreasing solution curve.
- This implies as q increases, the timing to reach peak decreases and delayed.

Note: The gaps between the latent reservoir and viral load are due to the delayed activation in latent infected cells.

- ## Pharmacodynamic Effects



- As seen in m_i and $n = \frac{MaxDrugDosage}{ED50}$, as they increase, the solution curves for the latent reservoir and viral load peaks declines.
- With large pharmacodynamic parameters, the peak timing of the latent reservoir and viral load are delayed further.