

# COVID and Cytokines

Simulating the immune system response to Covid 19:  
Why cytokine storms develop, and how to prevent this  
fatal condition

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# Foreword

- This draft is intended for those who wish to explore how the immune system responds to Covid, and how the often-fatal phenomenon of a “cytokine storm” develops.
- This private research is ultimately aimed at identifying the specific conditions that drive cytokine storms, and thus, ways in which to intervene to prevent this fatal condition from occurring.
- We seek referrals to subject matter experts who could guide further work.

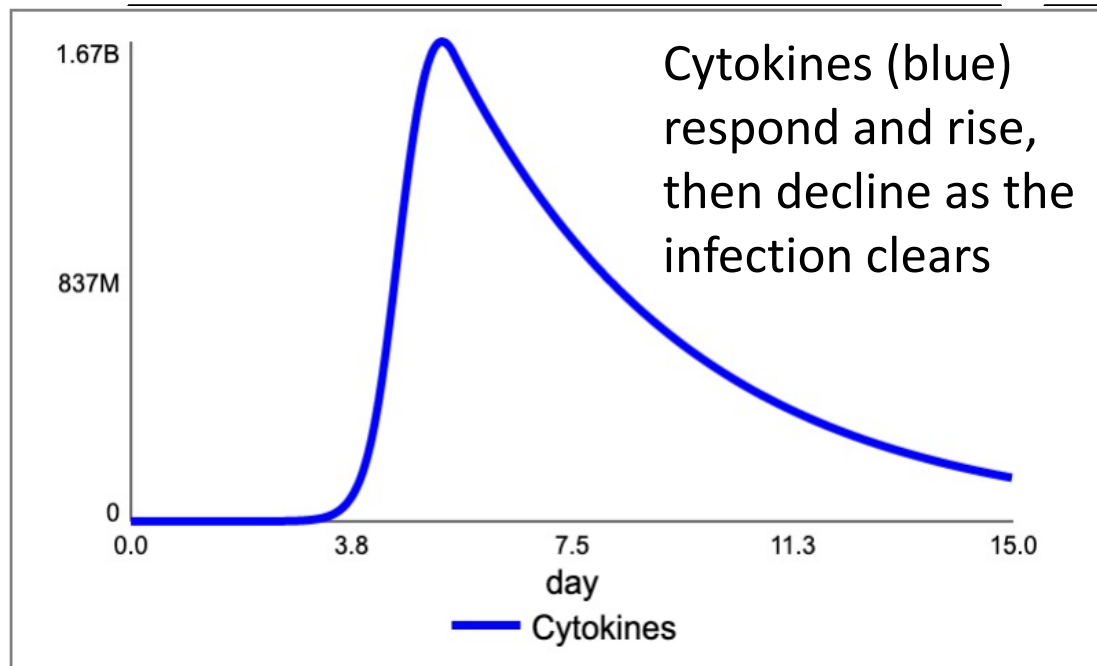
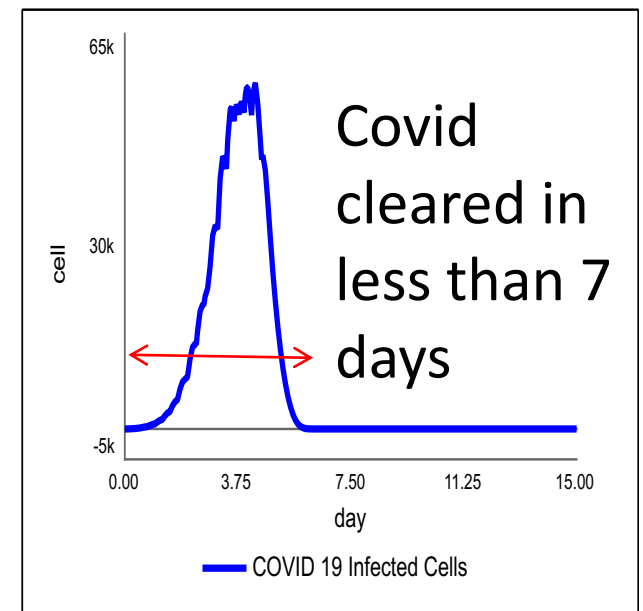
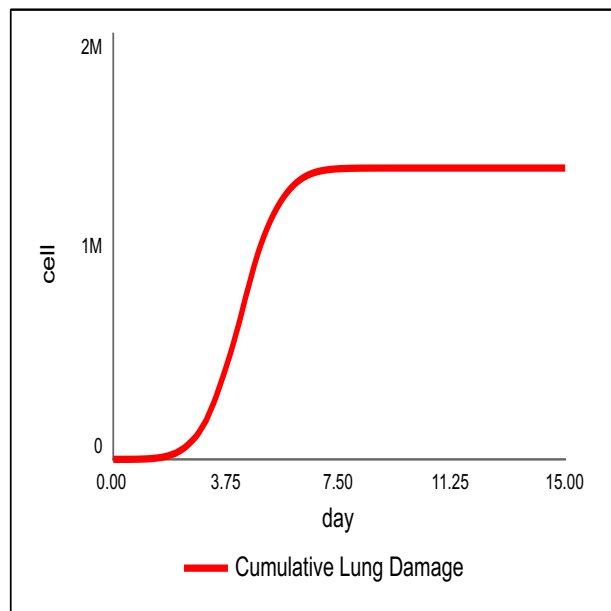
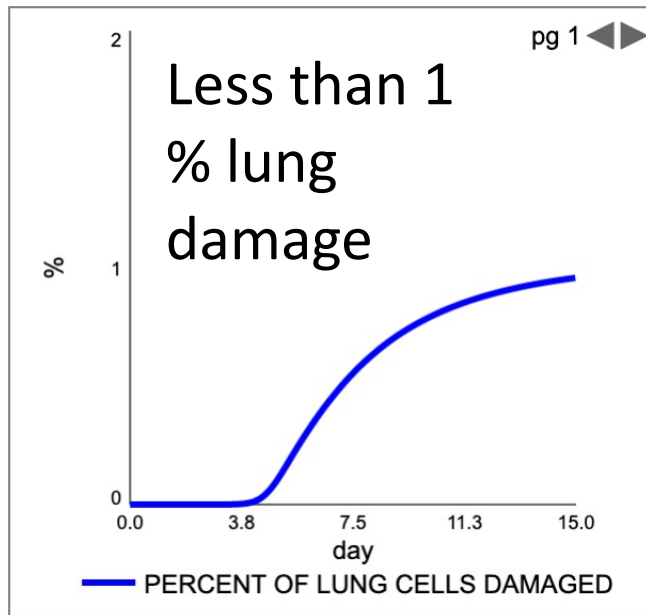
# Brief background on cytokines (from a non-scientist)

- Cytokines are extremely strong chemicals the immune system releases to gear up an immune response to be faster and stronger in battling any antigen, including viruses such as Covid-19.
- The escalation of the response is necessary, but involves a crucial *balancing act*:
  - *not enough* cytokine-induced activity, and the virus continues and worsens;
  - *too much* cytokine response, and it becomes that cytokine “storm” in which these immune chemicals themselves damage the lungs-fatally for many.
  - Indeed, that is what is responsible for most Covid deaths.

# Factors & interactions in the immune system response to Covid

- *The major factors in the current simulation model:*
  - *Covid-infected cells*
  - *Cytokines*
  - *T cells*
  - *Memory T cells--a key to mRNA vaccines*
  - *Lung damage caused by the virus and by cytokines.*



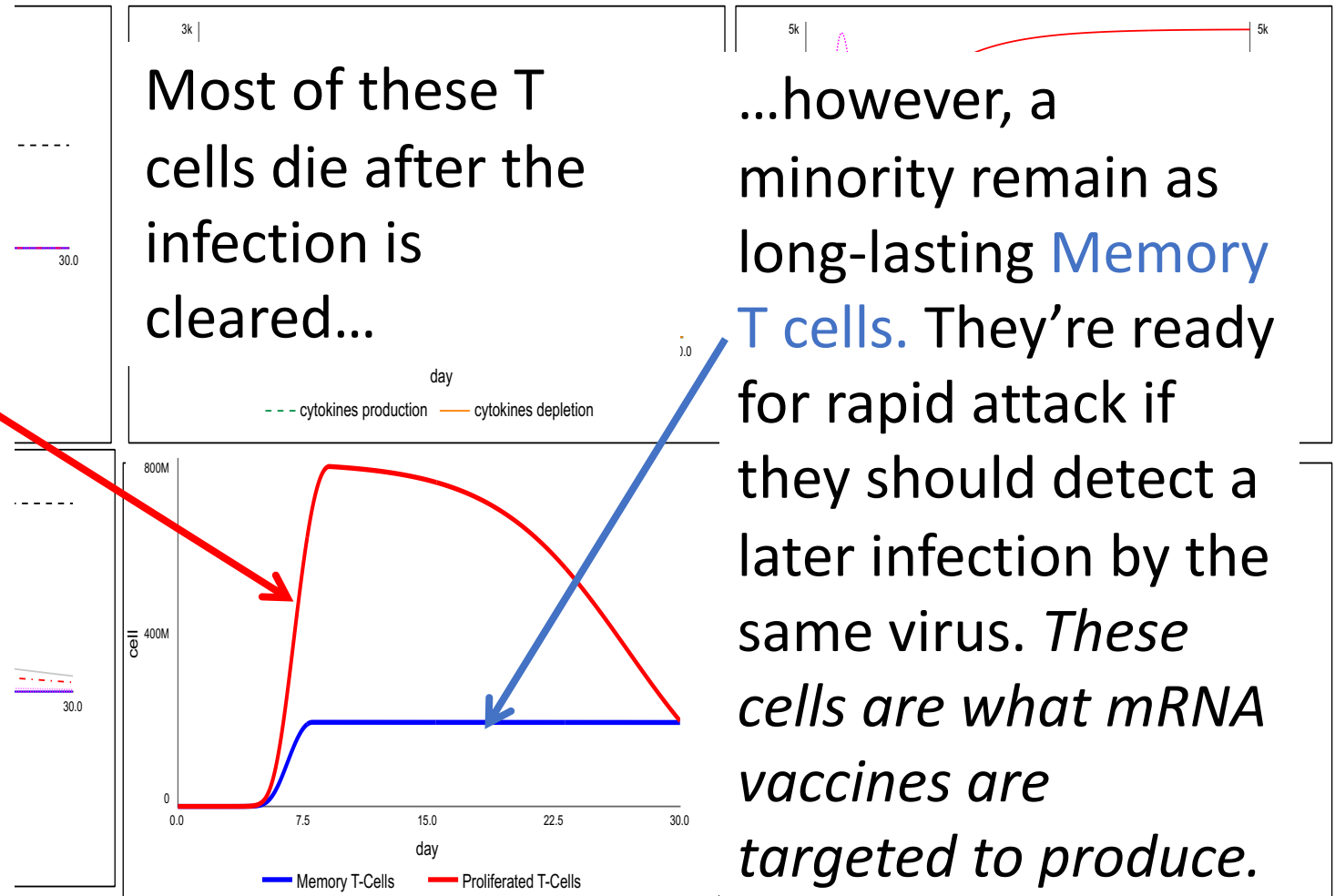


*This first scenario shows a very mild case of Covid, lasting just under a week. Here, cytokines enlist T cells to kill virus-infected cells, then settle down after the virus is cleared, with virtually no lung damage from either the virus or the cytokines. In other words, the way it's all supposed to work.*

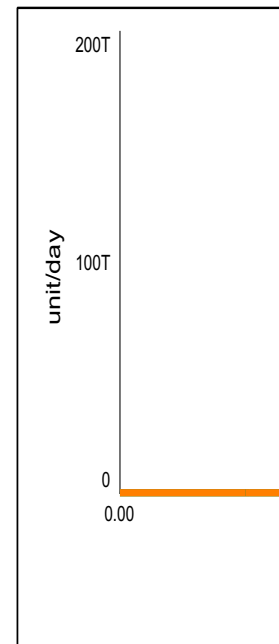
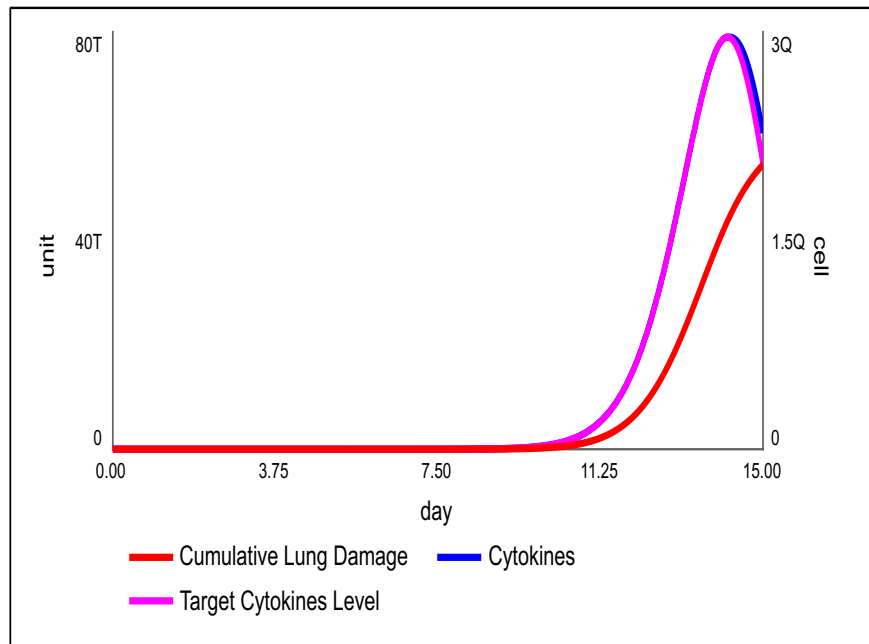
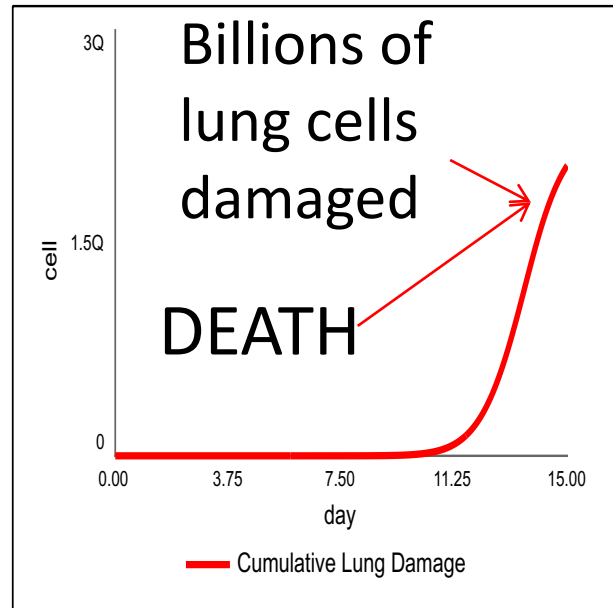
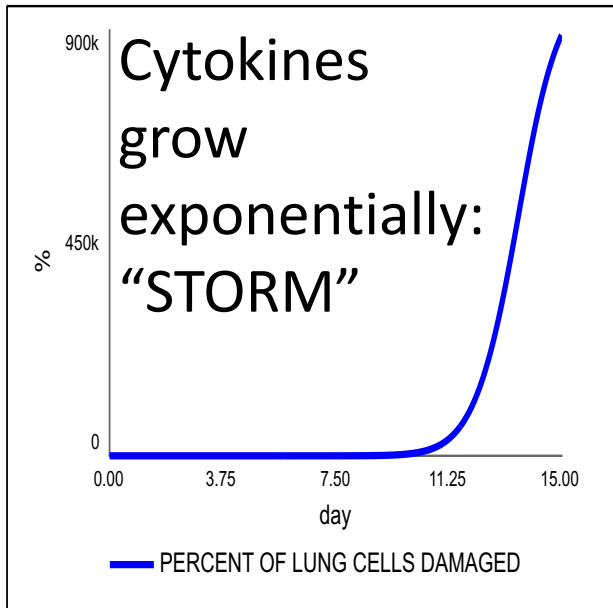
Upon viral infection, the rise of cytokines induces a strong **T cell response** to battle the virus. It becomes a “race” between the virus attempting to kill infected cells, and T cells attempting to kill the virus.

Most of these T cells die after the infection is cleared...

...however, a minority remain as long-lasting **Memory T cells**. They're ready for rapid attack if they should detect a later infection by the same virus. *These cells are what mRNA vaccines are targeted to produce.*



# Simulating a fatal cytokine storm...

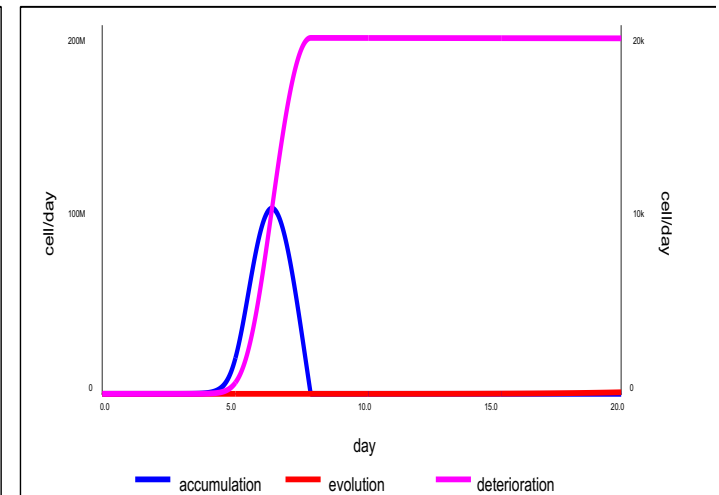
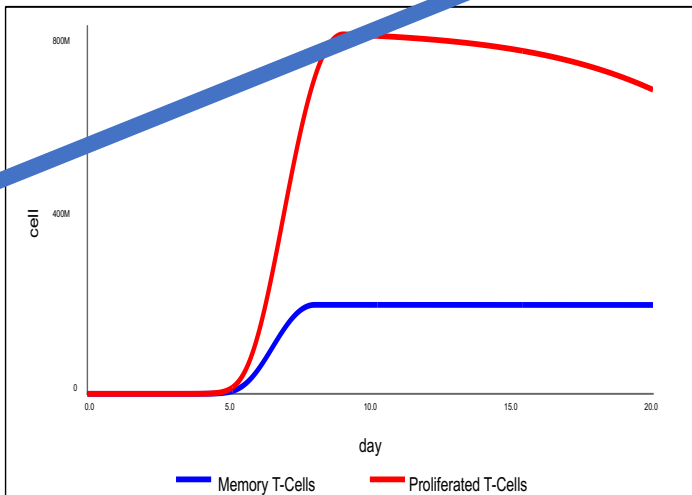
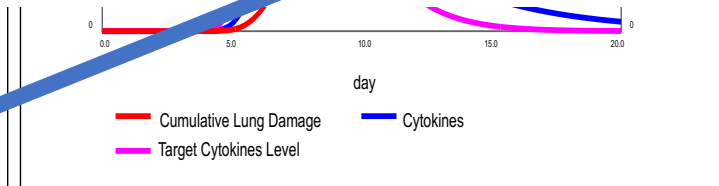
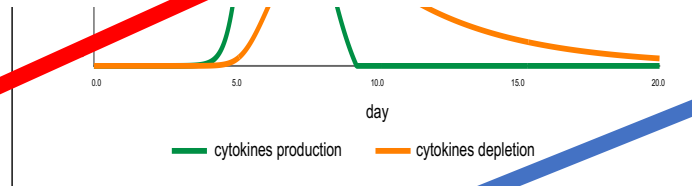
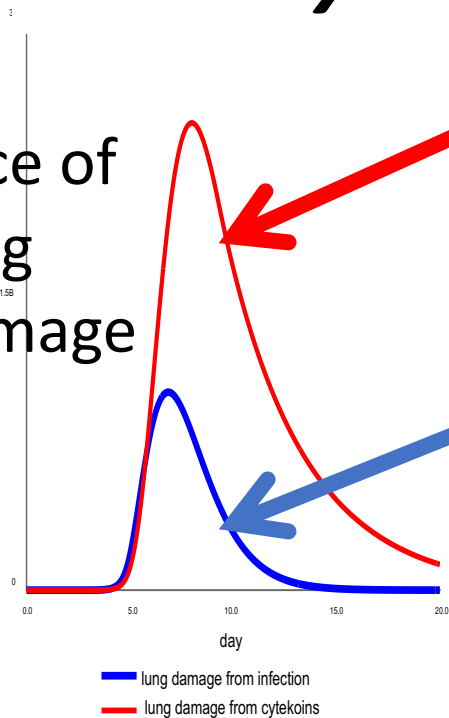


***A few input changes to the numerical factors yield a radically different outcome- in this scenario, the level of cytokines rages to very high levels, and lung function is destroyed by the "storm" (not the virus).***

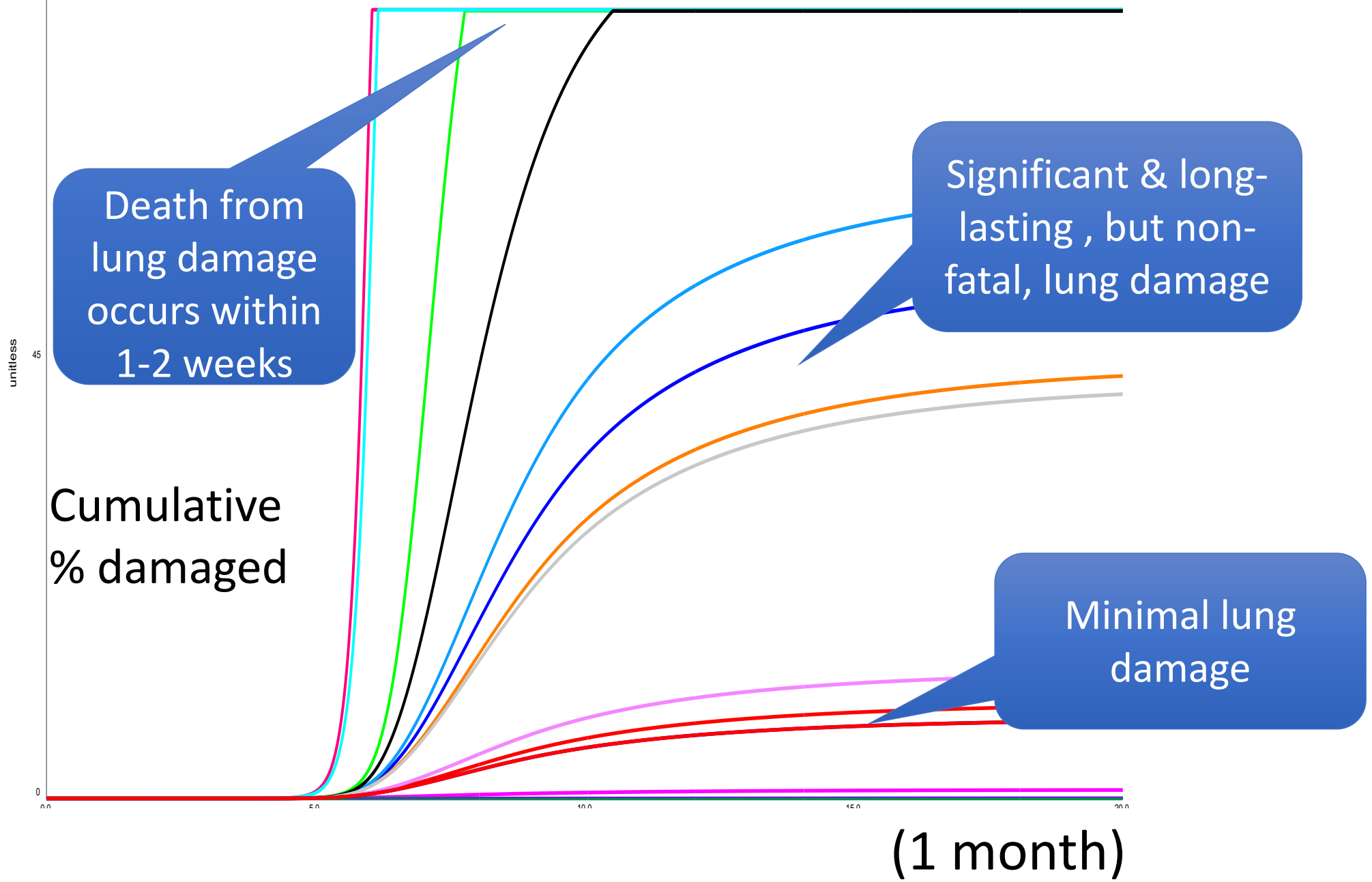


*The fatal level of lung damage is driven far more by the **cytokine storm** than the **virus**...*

Pace of lung damage



# Lung damage caused under slightly different conditions...



# COVID-19

How does *this*....

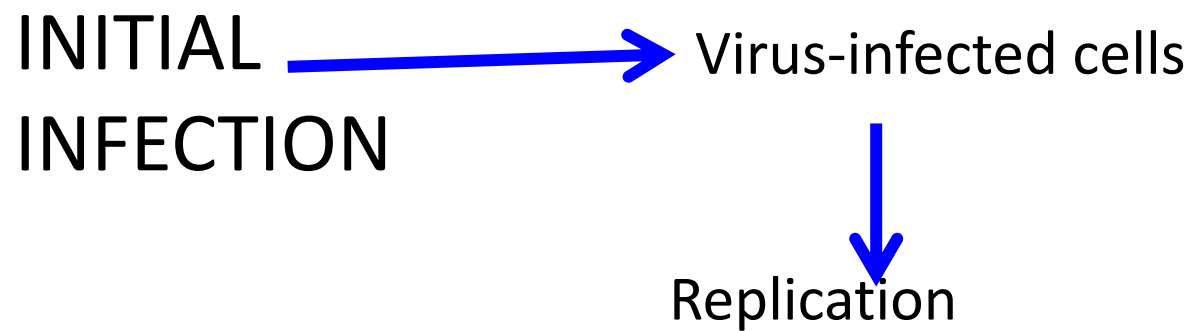


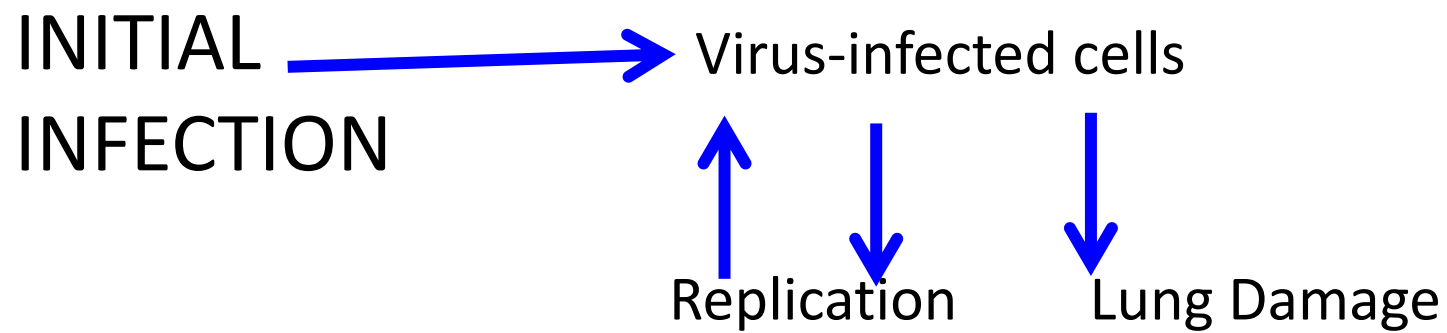
INITIAL  
INFECTION

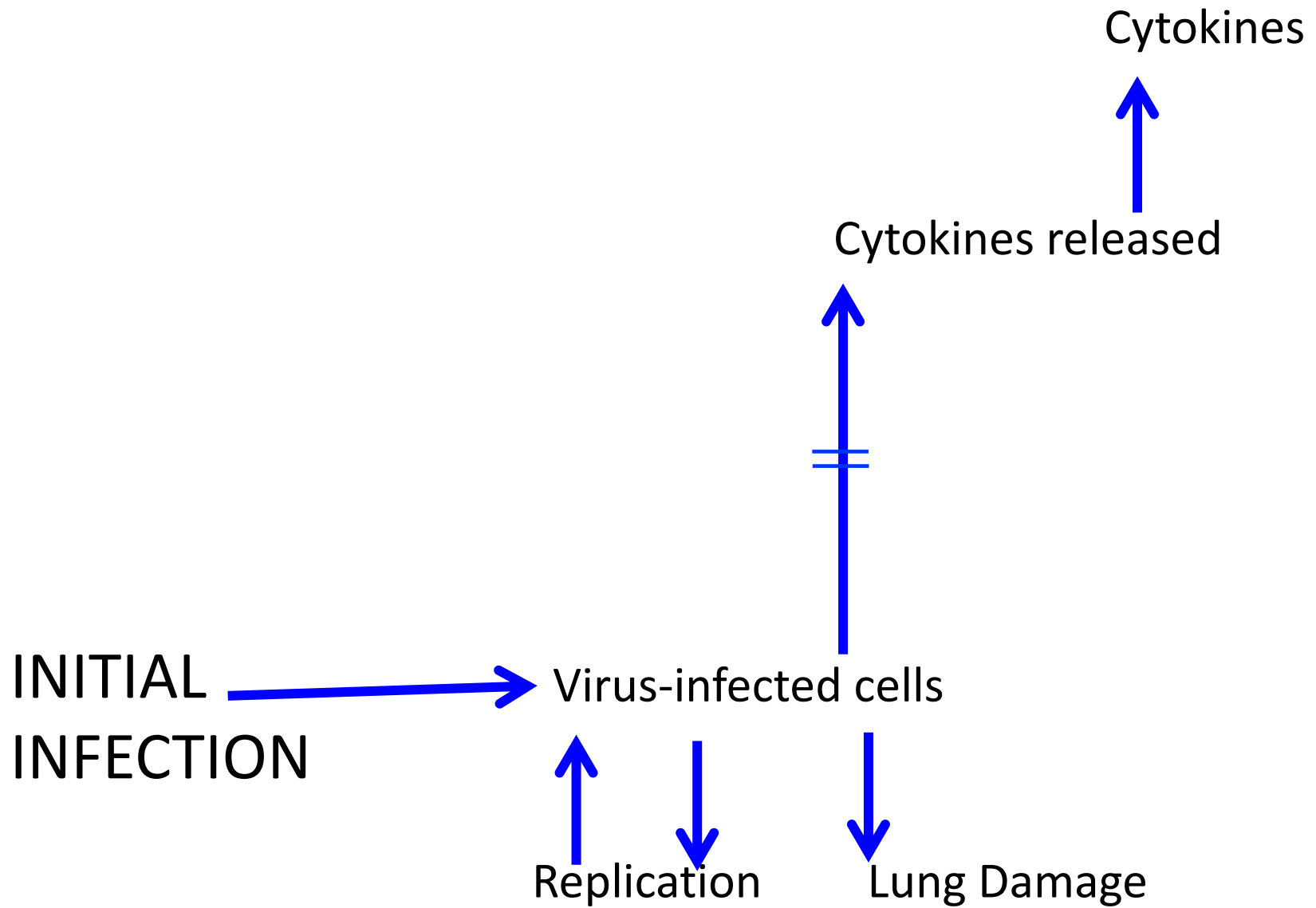
Lead to *this*?

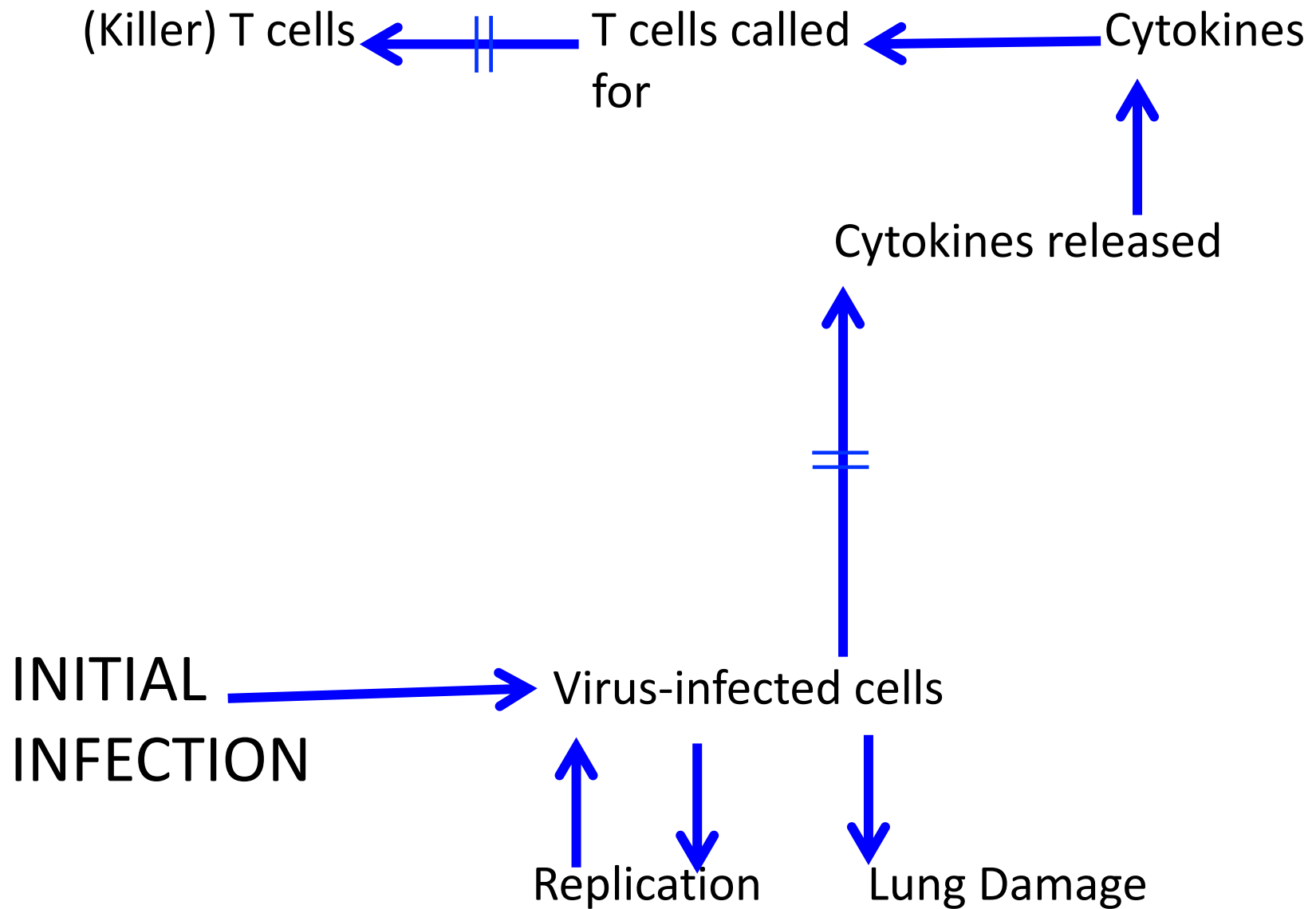


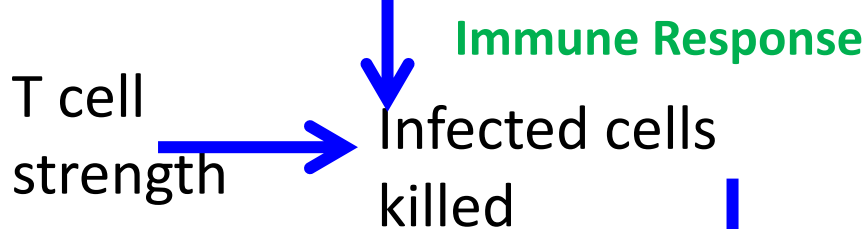
Cytokine  
storm &  
DEATH



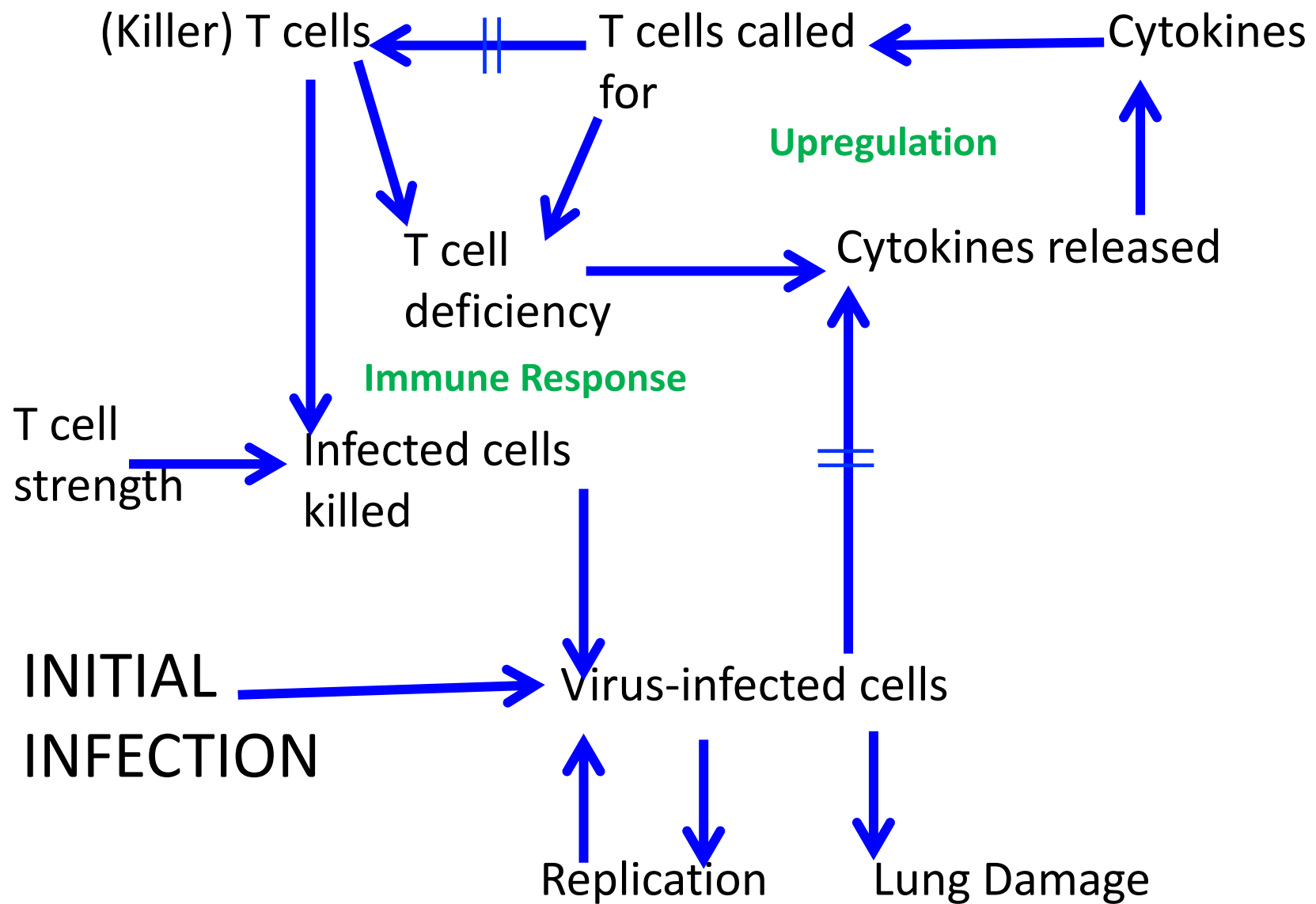


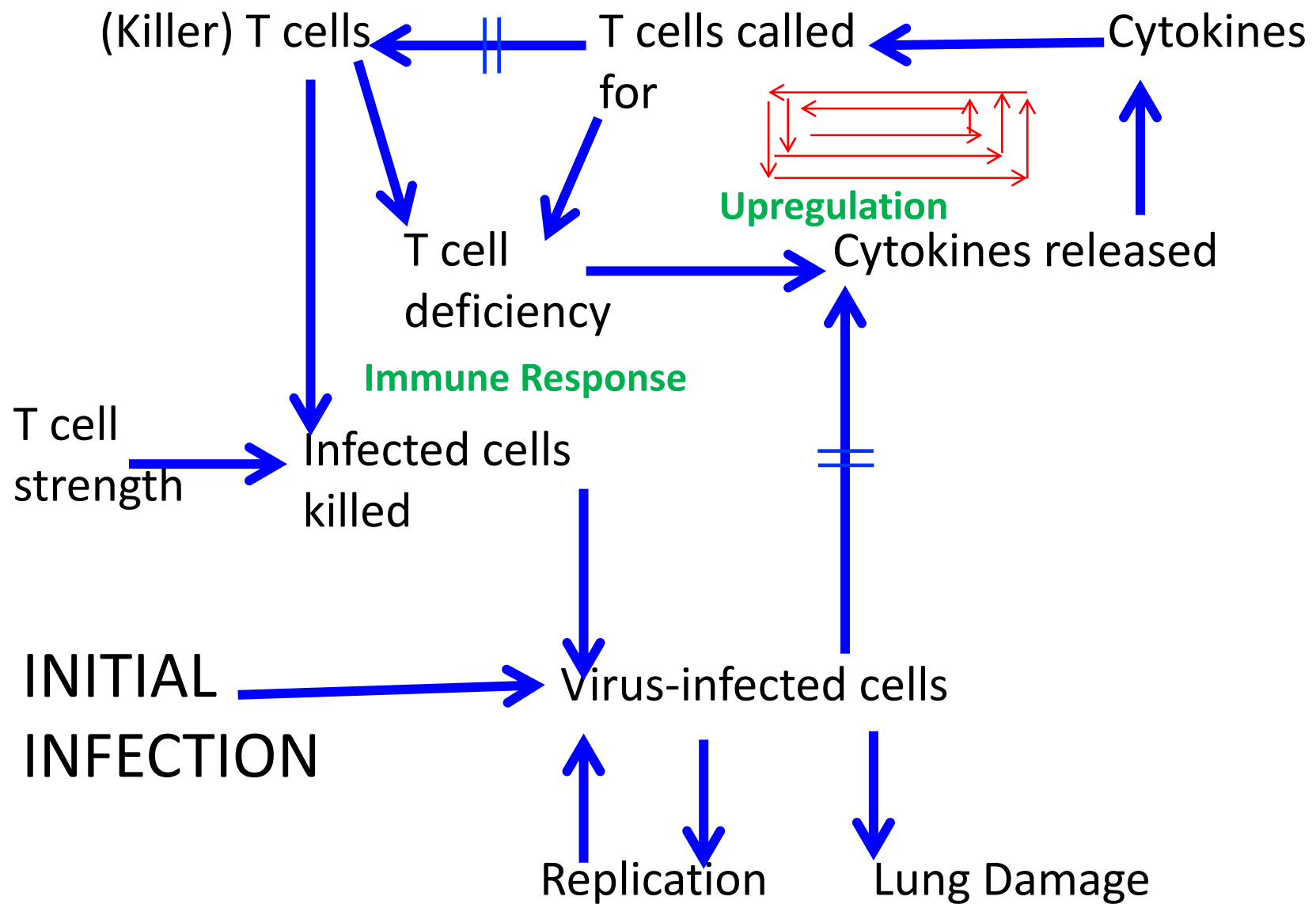


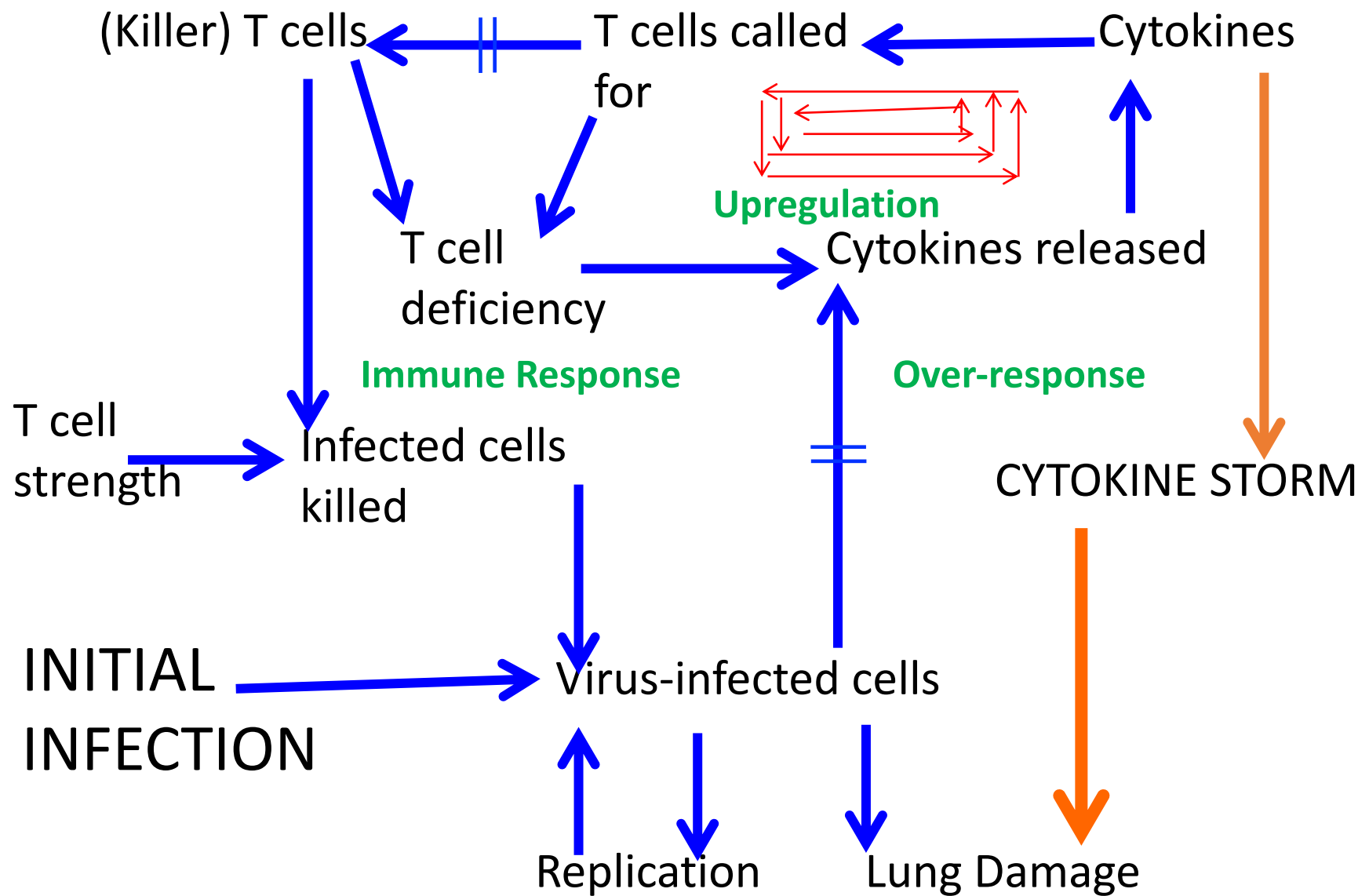


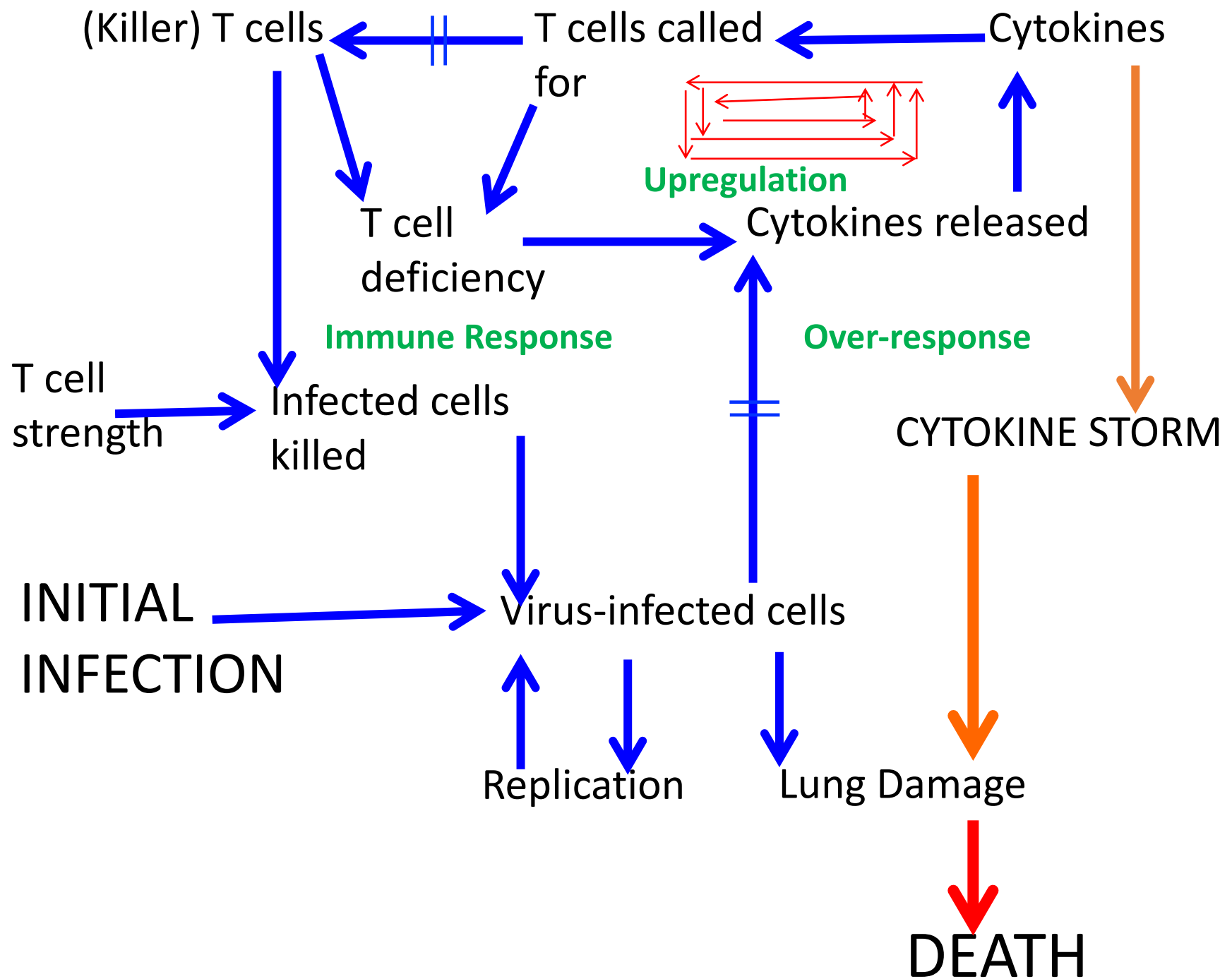












*In summary, our hypothesis:*

*In the immune system's quest to kill the virus, severe cytokine storms could be caused by an inadequate T cell response, thus causing a "snowballing" of cytokines trying to enlist more T cell action.*

There is *not* agreement in the scientific literature on the causes of cytokine storms, but our initial analyses support that hypothesis.

*The lung damage caused by cytokines (and thus, severe illness or death) depends **most** upon...*

*...the time delay in recognizing the virus*

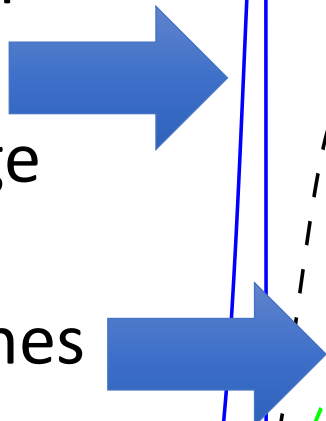
*...the speed at which cytokines respond to the virus*

*...the efficiency of cytokines recruiting T cells*

*...the speed at which T cells can proliferate*

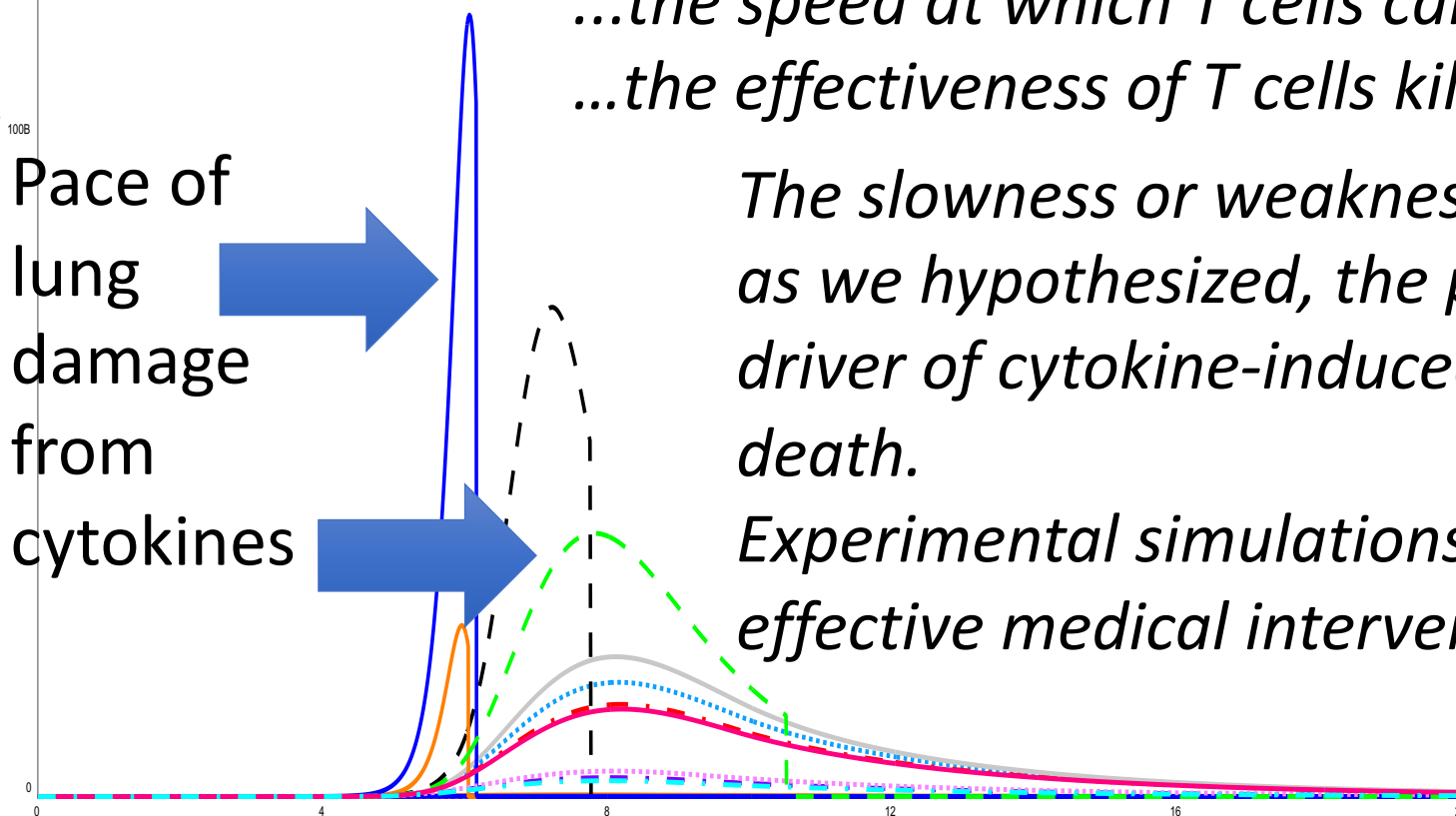
*...the effectiveness of T cells killing the virus*

Pace of  
lung  
damage  
from  
cytokines



*The slowness or weakness of T cell response is, as we hypothesized, the primary (simulated) driver of cytokine-induced lung damage and death.*

*Experimental simulations may point toward effective medical interventions.*



***Many factors matter...what matters most?***

# Next: We seek scientific guidance

To what individuals and organizations could this work could be taken, in order to:

(a) guide and refine further work,

(b) increase exposure and support for this unconventional approach, and

(c) translate future analysis findings into specific medical treatment candidates?

# Thank you!

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