Consider the following compartmental model:



S, E, I, R, and D are the number of individuals susceptible, exposed, infected, recovered, and dead. N is the number of individuals in the population. N = S + E + I + R + D.

β, γ, λ, and κ are rate constants such that

Epidemiology is not my field, but my academic interest is pharmacokinetics. Thus, when I see compartment models, I’m pretty comfortable with the differential equations even thought I think of drug mass while an epidemiologist thinks of fractions of populations. There are lots of representations of SEIR models, but the above one is simple enough to mathematically express the concept of feedback.

In the above model β is fixed, although some models permit λ and κ to vary with time (hopefully λ increases and κ decreases as we learn how to manage sick patients).

Feedback in the model requires that β be a function of the other states and rates. As a first pass, I suggest that β be a function of the instantaneous rates of illness and death, along the lines of

Where η and ω are the strength of then negative feedback.

The rational of the function is that the boundaries work. Initially and will be 0, so the function reduces to . As the rates of illness and death increase during the course of the pandemic, the limit of is 1, which places a lower limit on β of 0.

Does this make sense? If so, then I may try some simulations to see if it behaves as I expect it to. Specifically, I think that the system will rapidly rise, but will eventually start to oscillate around a steady state.

I appreciate any thoughts and feedback.

Sincerely,

Steve