Original model:

New idea (where you get sick by being bitten by a flea):

Assumption about proportion of flea population that is infected:

Where b is the bite rate of fleas and m is their natural mortality. This corresponds to assuming that infected fleas never lose the infection, and their dynamics are much faster than the host’s. Where KF is the flea carrying capacity, which we assume proportional to the total host population:

Plugging it all back:

Putting together the terms that depend on Sh and Nh \* Sh, we get:

Where the new constant c1 is:

Rearranging:

We now recognize a “new” carrying capacity for humans:

Leading to our final form:

Multiple hosts: