A general model of immune status

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The immune status is the concentration of specific antibodies, which appear after infection with a pathogen and remain in serum, providing protection against future attacks of that same pathogen. Over time the number of antibodies decreases until the next infection. During an infection, the immunity is boosted and then the immunity is gradually waning, etc. The densities of antibody concentration satisfy some partial differential equation with an integral boundary condition, which generates a stochastic semigroup. We present general results concerning asymptotic stability and sweeping of stochastic semigroups [1] and then we apply them to our model [2]. We also analyze special cases of the model, e.g. when immunity decreases exponentially; with constant increase of antibodies after infection; with a threshold concentration of antibodies at the re-infection; and with seasonal infections.

Keywords: immune status, physiologically structured population, stochastic semigroup, asymptotic stability, flow with jumps
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