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# RATIONAL bEHAVIOR AND SOCIAL COST FOR IMPERFECT VACCINATION

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The aim of our work is to understand what happens when a typical child disease that has almost none complications for children but significant complications for adults is prevented with vaccination at birth. It is expected that the vaccination decreases the rate of infection, and, as side effect, increase the age at infection. This last effect is enhanced if the vaccine loses efficacy over time.

For levels of vaccination below the herd-immunity threshold, as the disease has more complications for adults, the total cost of disease treatment for the society may be bigger of that it would have with no vaccination. We show that, from the point of view of the society, there is a threshold for the level of vaccination, and that below this threshold the cost for society is bigger with vaccination than without. Moreover, individuals may or not vaccinate their children according to their perceptions of expected cost, originating another threshold for the level of vaccination, now from the individual point of view, below which individuals don't vaccinate.

We consider an age-structured population divided in two groups: juveniles and adults. Each individual is vaccinated at birth with a certain probability $p$. Also, the vaccine is imperfect, because it only confers life-long immunity with probability $\lambda$, while with probability $1 - \lambda$ the immunity lasts only during the juvenile phase. We define the social cost and the individual joint costs of disease and vaccination.

Our aim is to describe the sets of parameters $\{p, \lambda\}$ where is better or worst to vaccinate, both from the point of view of the society or individuals and how these sets overlap. From here we study the Nash equilibria that occur and describe possible actions to attain such an equilibrium that benefits both the society and individuals.

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