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Draft of Introduction

As anyone who has kept up with current popular culture in the United States could tell you, a disturbingly large number of parents sympathize with a movement which denies the efficacy of vaccination. Since its inception roughly a decade ago, there has been no sign that the anti-vaccination ("antivax") movement is going away any time soon. This movement, specifically the mechanism behind its spread and proliferation, warrants modeling and investigation.

As this phenomenon has began somewhat recently, not much research has been conducted on the subject. Few studies have investigated the spread of anti-vaccination sentiment. However, a paper from Jimenez, Stubbersfield, & Tehrani (2018) claimed to find a distinction between the spread of both anti- and pro-vaccination sentiments, depending on the source from which a person heard them. In particular, they were able to show that vaccine information, regardless of its stance, was better transmitted when framed as an experience-based view from a parent rather than the medical viewpoint of a doctor. This could offer some insight as to how antivax information spreads. Parents with an antivax view would be better able to persuade others to conform with their view because of their experience-based method of persuasion. Thus, as more people are persuaded to antivax views, the group is better able to recruit new members.

In this paper, I plan to model the national dynamics of pro- and antivax ideologies over long time scales, taking into account government intervention during times of crisis. In order to accomplish this, I will use a system of differential equations to represent the relationship between citizens of a nation (who are either pro- or antivax), outbreak of preventable disease, and government intervention. This model is different than the previously mentioned study for a number of reasons. Primarily, the aforementioned study was not a mathematical model, but rather an investigation into the qualitative mechanisms behind the spread of information between individuals. It did not attempt to model large-scale social interaction over long time periods. In addition, the study did not investigate the influence of disease outbreak on government intervention and thus public opinion, which my model will incorporate. Despite these differences, the Jiminez, Stubbersfield, & Tehrani (2018) study can provide valuable information in the formulation of my model, in particular the probability that one person is persuaded to share the views of another regarding vaccination.

Although the full model has not yet been developed, I have a decent idea of what the results of the model will show. I expect the amount of antivaxxers to fluctuate over time. This will be caused by the dynamics between antivax propaganda and subsequent government intervention. Consider a

situation in which the antivax population is relatively low, so as not to have induced a significant amount of government intervention. In the absence of opposing views, we would reasonably expect the antivax population to grow. At some point, the anti-vaccination campaign would grow enough as to cause preventable disease to proliferate enough to warrant government action. Action taken by the government through differing initiatives is not distinguished in this model – rather, "government intervention" is taken to mean the lump sum of all government effort, whether this be in the form of urging medical doctors to educate their patients on the efficacy of vaccination, public service announcements, or initiatives from the Center for Disease Control to increase the reach of vaccination programs. One would expect that this would subsequently decrease the volume of people within the antivax movement, and hopefully thus lead to preventable disease decline. At some point, the government would deem the situation to be "under control" and cease their actions. However, antivaxxers are still out there, and would then increase in number once more. This cycle is likely to repeat *ad infinitum*.

This model does not seek to only investigate whether this is the case, but also to investigate as to what may be done in order to eradicate any anti-vaccination sentiment (if such a thing is even possible).

(The final version of this paper will be written with LaTeX, but since I'm still learning how to do the typesetting, this will have to do for now. Sorry!)

References

Jiménez, Stubbersfield, & Tehrani. (2018). An experimental investigation into the transmission of antivax attitudes using a fictional health controversy. *Social Science & Medicine, 215*, 23-27.