

Complexity DTC Mini-project Proposal: Blood-borne virus transmission on networks of cliques

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Background

Infectious disease remains a leading cause of human mortality and morbidity worldwide, particularly in the developing world. Epidemiologists look for patterns in disease data, hoping to understand the spread of pathogens and ultimately inform their control. Since we cannot do a controlled experiment by releasing dangerous transmissible agents into the human population, mathematical modelling has become an indispensable part of modern infectious disease epidemiology [1].

Hepatitis C is caused by a blood-borne virus (HCV) that infects millions of new cases each year, and contributes to hundreds of thousands of deaths [2]. Globally, the epidemiology of HCV infection is complex [3], but is most likely driven by injecting drug use.

Project

The networks of HCV transmission formed by injecting drug users (IDUs) can be modelled through the making and breaking of cliques. Once this approximation has been made, the population-level transmission dynamics for the virus can be written exactly.

The project will look at targeted interventions aimed at the IDU population to make optimal use of resources for control of blood-borne viruses. The methods used will be analytical formulation and numerical analysis of a high-dimensional set of ordinary differential equations. The end-users of this kind of work are public health workers.

This proposal can be extended either in mathematical / formal directions, by use of methodology from optimal control theory, or in applied directions in collaboration with Dr. Sutton from the Health Economics group of Birmingham University.

References

[1] M. J. Keeling and P. Rohani. *Modeling Infectious Diseases in Humans and Animals*. Princeton University Press (2007).

[2] <http://www.who.int/mediacentre/factsheets/fs164/en/>

[3] P. Vickerman et. al. Can hepatitis C virus prevalence be used as a measure of injection-related human immunodeficiency virus risk in populations of injecting drug users? An ecological analysis. *Addiction*, 105, 311-318 (2009).