Structural convergence of web graph, social network and malaria network: an analytical framework for emerging web-hybrid search engine

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Abstract: It is a well known truth that there is no malaria transmission without blood-sucking bites by mosquitoes. Since there is no blood-sucking without contacts, it follows that the contacts between human beings and mosquitoes can be exploited to generate contact networks. Active computational research in this area is geared at developing new frontiers in modelling malaria transmission through network theory and methods. Ongoing research in this area points to the fact that there are structural similarities between web graph, social network and malaria networks. It is the aim of this paper to explore the structural convergence and to exploit this to build a framework that will pave the way for developing web-hybrid search engines. Like the emergence of search engines revolutionised web research, it is expected that application of search engines in malaria research will make a tremendous impact in malaria control.

Keywords: structural convergence; web graph; social network; malaria network; web-hybrid search engine; PageRank; HITS.

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1 Introduction

Malaria is one of the most dangerous and widest spread tropical diseases (Global Risk Forum, 2009). It is a vector-borne disease that results from blood infection by protozoan parasites of the genus *plasmodium*, which are transmitted from one human being to another by female *anopheles* mosquitoes (Richard and Kamini, 2002). The four species of malaria parasites that infect humans are *Plasmodium falciparum, Plasmodium vivax, plasmodium malariae* and *plasmodium ovale*. Since malaria is a vector-borne disease, it follows that any research effort geared towards eradicating the disease could be termed incomplete if it ignores the prominent role of the vector in disease transmission. It is therefore not strange to hear such statements as "*Imagine there are no mosquitoes, then there will be no itch or scratch and no malaria*" as was commented by Jonathan (2011).

The importance of vectors in malaria transmission has led to a number of scientific researches geared towards tackling malaria eradication from the angle of vector control. One of such researches is the genetic alteration of mosquito DNA and subsequent introduction of large number of impotent males into wild populations. For instance, the Malaysian Government through its National Biosafety Board recently approved the release of genetically modified (GM) mosquitoes in some selected forests (Shiow, 2010). This is the second in history after the Cayman Islands (Ethan, 2010) which took place in 2009. About 6,000 GM mosquitoes, known as OX513A, developed by Malaysia's Institute for Medical Research (IMR) in collaboration with Oxitec (a UK-based biotech company) were released, with the hope that the male GM mosquitoes will compete with normal males for females. The expected effect is a drastic reduction in number of *A. aegypti* which is the vector that transmits dengue.

A sophisticated technology currently in its infant stage of development is the laser-wielding robot that can detect mosquitoes in the air and shoot them dead at an enormous rate of hundreds of pests per second. Two serious concerns expressed from public