Mathematical Models for Chagas Disease

Meir Shillor

Department of Mathematics and Statistics,

Oakland University, MI, USA

shillor@oakland.edu

We present mathematical and computational results for a model for the dynamics of Chagas disease. It is caused by the parasite T. cruzi that is transported by the vectors Triatoma infestans, and affects millions of humans and domestic mammals throughout rural areas in Central and South America. The chronic disease causes mortality and severe morbidity. To control the disease spread periodic insecticide spraying of the village houses is used and also bank blood screening.

The basic model for the disease dynamics consists of four nonlinear ordinary differential equations for the populations of the vectors and of infected vectors, humans, and domestic animals. It has time-dependent periodic coefficients to account for seasonality, and was developed in [1]. The main motivation for the model was to optimize the insecticide spraying schedules.

The model was extended to take into account congenital transmission in both humans and domestic mammals as well as oral transmission in domestic mammals [2]. In particular, oral transmission provides an alternative to vector biting as an infection route for the domestic mammals, who are key to the infection cycle. This may lead to high infection rates in domestic mammals even when the vectors have a low preference for biting them, and ultimately results in high infection levels in humans.

Another extension was to allow for random coefficients, reflecting the uncertainty in their values. The simulations show that the variations in some of the model parameters lead to considerable variations in the numbers of infected humans and domestic mammals.

References

[1] A.M. Spagnuolo, M. Shillor, G.A. Stryker, *A model for Chagas disease with controlled spraying*, J. Biological Dynamics **5**(4)(2010) 299–317.

[2] D.J. Coffield Jr., E. Mema, B. Pell, A. Pruzinsky, M. Shillor, A.M. Spagnuolo, and A. Zetye, *A Model for Chagas Disease with vector consumption and transplacental transmission*, to appear in PLOS.