Zombie math and swine flu

BY ROBERT SMITH?, CITIZEN SPECIAL SEPTEMBER 12, 2009 BE THE FIRST TO POST A COMMENT

Hundreds turned up fo the annual Zombie Walk on Robson Street Saturday.

Photograph by: Jon Murray, The Province

You're outnumbered, in fear of your life, surrounded by flesh-eating zombies. What do you do? Call the mathematicians, of course.

Recently, a group of mathematical modellers in Canada published an academic article that examined a fictional outbreak of zombies. You may be wondering why on Earth they would do such a thing. It's all part of a larger plan to save humanity. Not just from fictional zombies, but from all the real diseases as well.

While modelling zombies is obviously just a bit of fun -- it arose out of a class project on disease modelling and is being published in an upcoming academic book -- there are many lessons that zombies can teach us about how to tackle real-world problems. Faced with unfamiliar biology -- in this case, the dead coming back to life -- there's a problem. You can't use existing models, because they don't apply. But time is of the essence: the zombie hordes are invading! Or, perhaps more likely, there's a new disease and it's spreading quickly.

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First, you start with a basic model that captures the important elements of the "biology". In this case, individuals could be susceptible humans, infected zombies, or the dead, waiting to be reanimated. Then you use evidence and data to refine the model: adding in a latent period, quarantine, a possible cure, or swift, intense attacks by the army. By considering the biology hand-in-hand with the mathematics, we can refine the process until we have a fuller understanding of the situation. And the mathematics leads us to solutions: a critical quarantine level, a certain strength of drug, how often the army needs to attack the zombies. The process allows us to decide these things in advance, before the disease has spread.

By modelling zombies, we learn about the process of dealing with unfamiliar biology. When the zombie project was completed, it was a few months before swine flu appeared. Now there's a large-scale pandemic sweeping the world and we might need to take big decisions, often without knowing all the facts. If we wait too long, we lose our advantage. What to do?

Mathematical modelling can step in. The same process which leads us from the biology to the equations and back again can be applied to a new, unfamiliar disease. Or to an existing, but neglected disease. Many diseases in the developing world kill hundreds of thousands of people a year, yet they receive very little attention. For example, Chagas' Disease kills 50,000 people a year in South America -- more than the total number of death from SARS, West Nile virus and bird flu put together -- and yet it's largely unknown elsewhere. The reason? It primarily affects the poor, because the bugs that carry it can't get through plastered walls. But if your house is made of sticks, as many are in rural South America, you're at high risk.

Mathematical modelling can analyse intervention strategies, track the spread of the disease and determine which measures might work and which might be doomed to failure. All without costly clinical trials or long delays while data is collected.

Indeed, mathematical modeling has been at the forefront of diseases for a long time now. In 1911, Sir Ronald Ross used mathematical models to show that eradicating malaria was feasible, by predicting the tipping point for the number of mosquitoes you needed to kill. Malaria used to be endemic in the US, but worldwide spraying efforts almost eradicated it in the 20th century. It was the power of mathematical prediction which provided this insight -- and won Ross a Nobel prize.

Models have also been used to control more recent epidemics. The triple-drug cocktail that fights (but doesn't cure) HIV has given millions of people the ability to live with the disease and not develop AIDS. It was mathematicians, working jointly with biologists, who used the power of probability to realise in advance that three drugs in combination would be enough to control the disease.

It's true that zombies aren't real and some may consider it a waste of time to study a fictional outbreak. But learning from zombies lets us learn about life-saving cures for new or existing diseases. What's more, combining disease with zombies tells us more about ourselves, by tapping into two primal fears that humans have: being eaten by a predator and being killed by a virus. It's too bad that only one of them is fictional.

Zombies are a fun example of a much larger process of understanding the world. The power of mathematical modelling provides insights that we can't grasp otherwise, allows us to model hypothetical outbreaks before they occur and lets us consider a variety of potential outcomes without lengthy experiments or expensive trials. Those things are important, of course, but mathematics can light the way forward. So if the zombies do turn up, reach for the nearest calculator. It might just save your life.

Dr. Robert Smith? (the question mark is part of his name) is an assistant professor at the University of Ottawa in the department of mathematics and the faculty of medicine whose research includes creating mathematical models of infectious disease. He is one of the authors of an academic article on mathematical modelling of zombies that can be found at: http://www.mathstat.uottawa.ca/~rsmith/Zombies.pdf