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Using math to calculate the spread of HIV/AIDS

Network Can math help solve the AIDS crisis? First-of-its kind summit will find out

'Questions of disease spread are very mathematical,' says James Watmough, associate professor of mathematics and statistics at UNB. 'You've got interactions between people's immune systems and the viruses on one level, and you've got to describe and figure out how the disease transmits from person to person.' Watmough will join other experts in Kampala, Uganda, next week to discuss HIV/AIDS and other diseases. He'll be using his expertise in mathematical models that study and predict how infectious diseases spread.

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A University of New Brunswick mathematician will join a variety of experts in Kampala, Uganda next week to add his savvy to a discussion of HIV/AIDS and other diseases.

James Watmough, associate professor of mathematics and statistics at UNB will meet with scientists, health officials and front-line workers in what's being hailed as a "first-of-its-kind" summit.

He'll be using his expertise in mathematical models that study and predict how infectious diseases spread, with an eye to developing strategies for how best to fight them. He'll also work to build collaborations that will help develop the next generation of disease researchers.

A national math research network known as Mathematics of Information Technology and Complex Systems (MITACS) is funding the three-day meeting, which runs from Monday through Wednesday. Based in Burnaby, B.C., the network brings together researchers and companies to solve problems in society and industry. It began its work on modeling infectious diseases after the 2003 outbreak of severe acute respiratory syndrome (SARS) in Toronto.

Attendees from other Canadian universities such as Manitoba, York, McMaster and Ottawa will be on hand. Researchers from Botswana, Uganda, Zimbabwe, South Africa and Kenya will also participate, as will the AIDS Support Organization (TASO), the largest non-government HIV/AIDS service provider in Africa.

Surrounded by mountains of papers he's supposed to be grading, Watmough doesn't claim to be supremely organized. But he's at home when it comes to studying patterns.

He never expected to end up working on diseases, but it's the problem-solving that attracted him. He also has done work on insect populations, and said the same types of mathematical models carry over to studying how human diseases spread.

"You get mathematics everywhere; anywhere you want to quantify something," he said. "These questions of disease spread are very mathematical. It's something that's dynamic. You've got interactions between people's immune systems and the viruses on one level, and you've got to describe and figure out how the disease transmits from person to person."

At the meeting, scientists will use mathematical modeling to simulate a disease outbreak in a specific population, allowing them to test various strategies to control its spread.

"Ideally we'll get together, sit down there and actually discover something from the mathematics that might actually slow or stop the spread of these diseases and could save lots of lives," said Watmough. "But it's probably not so clear-cut. There are all kinds of steps along the way, from development of vaccines to distribution (and) what types might be good to look at."

Studying the spread of HIV/AIDS comes down to studying interactions between and among social groups, said Arvind Gupta, the network's scientific director.

Those groups could be based on geography, ethnicity, sexual preference or religion.

"If group A is infected and C is not, you might put work into stopping it going through B because if you stop B you don't have to put work into C," Gupta explained.

"We're basically looking for choke points where we can target the disease and choke it off from spreading to new groups. If you're going to put money into prevention strategies, you want to put it where you have the best chance of stopping the spread of the disease."

Canada "has done an exceedingly good job overall in curtailing AIDS," in part because of such strategies, said Gupta. But sub-Saharan African faces a much graver situation than Canada, where roughly 60,000 live with AIDS, according to the federal government.

According to international AIDS charity avert.org, about one million Ugandans (out of a population of 27.6 million) were living with AIDS in 2005, including nearly seven per cent of its adults. And other countries are much worse. South Africa has 5.5 million people living with AIDS, including nearly 20 per cent of its adults.

An estimated 24.5 million adults and children in sub-Saharan Africa suffer from the disease.

"The idea here is to take our expertise into Africa and see if it's possible to build similar models in East Africa and understand how it's spreading and what the social groups are," said Gupta.

"If we can do what we've done here to help part of sub-Saharan Africa, I think that would be a major Canadian contribution to humanity."