Maths model to prevent deadly disease spread

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Postdoctoral fellow Joanne Mann.

Innovative mathematical models designed to calculate which sectors of the population need vaccinating during an infectious disease outbreak could save money and lives.

By targeting those most vulnerable to disease, the model enables health authorities to prioritise human resources and vaccine supplies.

Joanne Mann, who graduates from Albany campus tomorrow with a PhD in mathematics, has created several models for the epidemiology of vaccine preventable diseases. Part of her thesis focused on the Ministry of Health's Meningococcal B immunisation programme and its effectiveness in deterring the spread of the deadly disease. She found the ministry's strategy was the right approach.

The number of meningococcal B cases steadily increased in the 1990s from fewer than 10 cases a year and peaked at 370 in 2001 at the height of the epidemic. The immunisation programme was targeted at those aged under 20 because young people made up 80 per cent of the cases. It began in 2004 and within three years the number of epidemic strain cases had fallen to 47. The campaign cost $220m and resulted in more than a million people being vaccinated. It ended in 2008.

"Our model showed that the vaccination campaign successfully reduced the number of people who would have been infected, but does not prevent another epidemic occurring in the future," says Ms Mann. "However, we showed that by implementing a similar vaccination campaign as soon as the number of infections of meningococcal B begin to rise, the epidemic can be halted quickly."

One of the major benefits of her model, based on the yearly incidence rate for meningococcal B from 1996-06 and vaccination data from 2004-06, is that it can calculate the number of "silent spreaders", or people who are unaware they are carriers of an infection. The model can be adapted to other infectious diseases such as hepatitis B. It can be used to target high prevalence regions and susceptible population groups, and take into account the different immune times for those who have been acutely affected, those who are carriers and those who have been vaccinated.

"When the incidence of an infection starts to increase in any population, people start to look at how best to combat the outbreak or at least to curb the number of infections. Launching nationwide vaccination campaigns - or even vaccinating a small group of a population - can be a costly and time-consuming endeavour, so any tool that will enable the campaign to be more directed or to predict the outcome is highly valuable."

She says vaccination is one of the most cost-effective ways of combating infectious diseases. "Although vaccination against many childhood infections is highly recommended by health professionals, it is not compulsory. However, the choice to be vaccinated not only affects the protection of the individual against the infection, but also the immunity of the entire community through 'herd immunity'."

A former pupil of North Shore's Carmel College, she is now a postdoctoral fellow at the Institute of Information and Mathematical Sciences working on a project using mathematical modelling to simulate the spread of flu viruses- including swine flu in New Zealand and the Netherlands.

Provided by Massey University

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