Physicists develop technique to save more lives by vaccinating fewer people

December 7 2016

The method uses complex data to identify people whose patterns of activity make them more likely to pass on an infection. Credit: University of Aberdeen

Scientists at the University of Aberdeen have developed a mathematical method to prevent epidemics by vaccinating fewer people than ever before.

They have hailed the method – known as 'explosive immunisation' - as the fastest and most efficient way to prevent the spread of disease.

The method uses complex data sets to identify so-called 'superblockers' - typically well-connected people who move between different communities, whose patterns of activity make them more likely to pass on an infection.

By targeting them for vaccination, the proportion of those requiring treatment is dramatically decreased.

Early mathematical modelling carried out by the research team has predicted that targeting just 60% of the UK population with the MMR vaccine using their method would prevent a measles epidemic. At present over 90% of the population receive the vaccine.

The development of the method is the result of a research project funded by the Leverhulme Trust and the COSMOS Horizon2020 project, involving scientists from the University's School of Natural and Computing Sciences and Professor Peter Grassberger, a Leverhulme visiting scientist.

Dr Francisco Perez-Reche is part of the University research team, along with Professor Antonio Politi and Pau Clusella. The results of their work have been published in *Physical Review Letters*.

Dr Perez-Reche said: "It would be ideal to prevent epidemics by vaccinating as few individuals as possible. Not only would this offer a faster and more efficient solution, it would also save money and resources for agencies who might otherwise struggle to cope with an outbreak.

"In principle, this can be achieved by identifying key individuals for vaccination but it is a very challenging task in an increasingly connected world.

"Explosive immunisation ranks individuals according to their ability to block the spread of infection if vaccinated, using the wealth of complex data we now have at our disposal to identify networks of contacts.

"This data can be comprised of anything from networks of everyday

encounters extracted from surveys or mobile phone usage, to global networks that can be identified through airport passenger data.

"By utilising this data we can accurately identify superblockers who, if not vaccinated, dramatically increase the possibility of an epidemic. It is because of this sudden increase that we have called the method explosive immunisation."

Professor Politi added: "Most targeted immunisation strategies identify those who require vaccination by the number of contacts they have, but our method looks at the whole network to identify patterns of connectivity that allow us to more accurately identify who should be vaccinated.

"This, we believe, provides a faster and more efficient way of preventing epidemics than any other existing technique."

More information: Pau Clusella et al. Immunization and Targeted Destruction of Networks using Explosive Percolation, *Physical Review Letters* (2016). DOI: 10.1103/PhysRevLett.117.208301

Provided by University of Aberdeen