Catching swine flu: how big data helped doctors to understand a pandemic

A specialist team from Telefónica used mobile network data to understand how people moved around during the swine flu pandemic. Their findings helped to validate a government's response to the crisis.

The 2009 H1N1 flu pandemic was known as swine flu. Scientists believe the virus had its origins in Mexico, but its real source is unknown. At least 250,000 people are known to have died because of the disease, though the real figure may be much higher.

One of the keys to finding out how viruses spread is to understand the way people move around as they go about their daily business. The swine flu pandemic was an early example of how mobile phone data can be used to analyse trends and patterns of movement.

Telefónica Digital's research team used mobile phone call records to measure the number of people visiting busy locations such as universities or airports. The aim was to use this anonymised and aggregated data to learn about the movement of people in a pandemic crisis.

Analysing the event

When the swine flu epidemic was first identified in April 2009, the Mexican Government took action to try to limit the movement of people around the country. They closed a number of busy public places, including airports, hospitals and university campuses.

The first study used call detail records of one million customers from one of the most affected Mexican cities. Through these records the government could reliably measure the number of people at three of the key locations closed – a hospital, a university and an airport. To protect our customers the data was encrypted and anonymised, and the results were aggregated.

It looked as though the measures had worked. Call traffic from the university was much lower than normal. The hospital saw no change in call levels, which suggests that people also followed the Government's advice to stay away from hospitals unless they had serious injuries or illnesses. By contrast, the airport received twice as many visitors as usual. It may have been that people were ignoring Government advice and flocking to the airports in a bid to leave the country.

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Building the model

The next step for the project was to create a model that would allow a comparison between what actually happened, and what would have happened if the Government had not intervened. The aim was to show what difference the Government action made to the spread of the disease.

This time, the researchers used anonymised and encrypted call detail records gathered over five months, including the time when the Government measures were in place.

They created computer programs to model how the disease might spread, based on the findings from the first study. The models were very realistic, because they could be based on actual patterns of movement. Each individual was modelled separately, creating approximately two million simulations of people infected with the H1N1 virus.

With the models built, the team could then run simulations of how the disease would evolve. They used two scenarios: the baseline scenario showed what would have happened if the Government had not taken action; the intervention scenario modelled the outcome of the Government's control measures.

The results

These simulations showed that there was a drop in patterns of movement of between 10% and 30% as a result of the Government's action. The peak of the epidemic was postponed by almost two days and the number of infections was reduced by 10%. Clearly, the Mexican Government's strategy had worked.

Conclusion

Computer models have long been a part of medical research. The difference in this case is that the models were far more detailed and accurate, because the epidemiological data could be combined with the aggregated and anonymised call records, based on actual behaviour.

It's a model that can be applied to any future threat from H1N1 or other variants of the virus. Shutting major centres like hospitals or airports is a big decision for any government. The better the data, the more certain the decision-makers can be of their strategy.

The Telefónica team behind the study is already talking to institutions such as the World Bank about other uses of this technology. The learnings and algorithms from the Mexico study could be applied to other cases such as crop disease, mass migration and other evolving pandemic threats.

And now the algorithms developed during this research can be combined with Telefónica's new Smart Steps product. Smart Steps uses fully anonymised and aggregated mobile network data to enable organisations to measure and compare the movements of crowds. Combining Smart Steps with the research models can help to generate deeper insights into the link between human movement and the spread of infectious diseases.

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