



ESRI Canada

Case Study

Ground-breaking application predicts the spread of infectious diseases in a globalized world



St. Michael's Hospital proves link between air travel and the spread of infectious diseases

With more than two billion passengers flowing through the global airline transportation network every year, infectious disease threats that once were localized can now rapidly transform into global epidemics, compromising global health, security and prosperity. A scientific research team based out of St. Michael's Hospital has developed a platform that enables rapid analysis of human movement through commercial air travel and its correlation to the international spread of infectious diseases.



Challenge

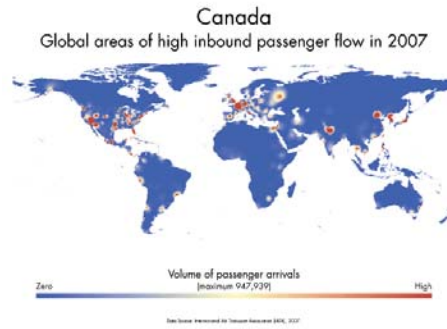
In 2003, the worldwide outbreak of SARS revealed an urgent need to improve pandemic preparedness and response strategies on a global scale. Many countries were ill equipped to manage the outbreak which led to thousands of infections, hundreds of deaths and billions of dollars in economic losses around the world. More recently, the H1N1 'swine flu' epidemic has evolved into a worldwide pandemic with global health and economic consequences greatly exceeding that during SARS.

Although epidemics like SARS and H1N1 are inevitable, there is a limited amount of research into the role of commercial air travel as a conduit for the spread of infectious diseases. This is highlighted by the fact that national and international pandemic influenza plans do not currently account for global patterns of commercial air traffic and their implications on preparedness and response strategies. Research into global population mobility is also limited by a lack of quality data on the global airline transportation network and worldwide commercial air traffic patterns.

To address this knowledge gap, a multidisciplinary scientific team based out of St. Michael's Hospital in Toronto, Ontario developed BIO.DIASPORA – a scientific platform that enables methodological and applied research into the relationship between commercial air travel and the global spread of emerging infectious disease threats.



Human population density is integrated with international flight pathways out of Toronto to show how Toronto is connected with the world's population through flight pathways.



Heat map revealing areas of the world where the highest volumes of airline passengers travel to Canada.

“With ESRI’s broad capabilities, we were able to quickly produce maps and put them on the Web. We will continue to move towards Web mapping as a powerful vehicle to communicate our findings across the globe.”

Dr. Kamran Khan, MD, MPH, FRCPC
 Centre for Research on Inner City Health
 Division of Infectious Diseases
 St. Michael’s Hospital

Solution

To create the BIO.DIASPORA architecture, three key software components were fused together. SAS business analytics software was implemented to integrate and manage data, MATLAB technical computing software was used for data analysis and numeric computation and ESRI’s ArcGIS technology provided a powerful visualization component that brought the data to life through a range of compelling Web maps.

A wide range of data sources were then secured and integrated including worldwide passenger ticket sales for over two billion passengers, global flight schedules, real-time flight status data and global airport data.

The team leveraged ESRI’s robust functionality to create heat maps, contour maps and simulations that could answer key questions such as: Where are the vulnerable points of entry in this province? What is the probability of the spread of infectious disease based on a defined set of criteria? How many international passengers arrived in a particular city in 2007?

The application facilitates an understanding of how humans travel via commercial airlines as a way to predict how infectious diseases are most likely to spread around the world. Next, the team will leverage ESRI’s modeling and analytic capabilities to look at the role of temperature, humidity, rainfall and human/ animal interaction in the spread of infectious diseases.

Benefits

BIO.DIASPORA was used to accurately predict the spread of the H1N1 virus through an analysis of international passenger departures out of Mexico, and subsequently, proved a correlation between air travel and the spread of infectious disease during the pandemic.

The application has since been used to analyze Canada’s vulnerability to emerging infectious disease threats and based on findings, offers valuable suggestions to help strengthen Canada’s emergency preparedness and response capabilities. It will also track population movement related to the 2010 Vancouver Winter Olympics and compare these results to findings from the past five Olympic Games with an aim to identify significant trends and patterns.

At the end of November, the biggest mass gathering in the world will occur as millions of people from around the world participate in the Hajj - an annual pilgrimage of Muslims traveling to Mecca, Saudi Arabia. As masses of people flow in from around the globe, it is anticipated that the H1N1 virus will likely be introduced into Mecca, which may result in local transmission during the Hajj, subsequently altering the global evolution of this pandemic as infected pilgrims travel back to their home countries. BIO.DIASPORA will be used to predict which countries may be most vulnerable, and these findings will then be used to try and secure H1N1 vaccine donations for countries in greatest need.



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Founded in 1984, ESRI Canada provides enterprise geographic information systems (GIS) solutions that empower businesses, governments, and educational institutions to make timely, informed and mission-critical decisions by leveraging the power of maps. The company distributes the world's leading GIS software from ESRI, Telvent Miner and Miner, Azteca Systems and other technology partners. Headquartered in Toronto, the company serves over 10,000 customers from 16 regional offices across Canada.

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