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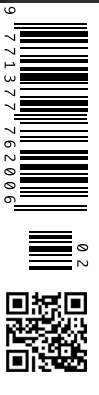
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How Data Intelligence Will Be Crucial for Predicting the Next Pandemic

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Artificial intelligence developments in machine and deep learning are benefiting from the experience of COVID-19 to pave the way for future pandemic outbreaks.



Key Points

- The generalised use of big data in healthcare implies a revolution that is reshaping the industry as we know it.
- Artificial intelligence has shown to be the key for unveiling trends in the spread of COVID-19.
- The lessons learnt through the application of machine and deep learning in the healthcare sector will be vital for predicting and preventing the spread of future outbreaks.

Over the last few months, we have understood that COVID-19 is a unique pathogen, highly contagious and capable of causing significant health, economic and social impact.

The speed of the spread and the effect on certain populations have both alerted and inspired medical doctors, health-care practitioners as well as data scientists, to try and find a solution and a future means of prevention.

No one can predict the future. We may be able to grasp hints of events to come, based on our previous experience and assessment of multiple factors and variables, but there is no clear certainty of what is next.

In the context of the current COVID-19 pandemic, we have learnt that big data plays an important role in better understanding the different characteristics of the virus around the

geographical evolution of the spread of the virus.

One example is an application that helps researchers determine the speed with which the virus is spreading and the areas in which this is happening, the regions in the country with higher risks, and the persons at risk, depending on the evolution of their symptoms (King's College London 2020). This application has also been applied in the project [TwinsUK](#), mapping the incidence of genetic basis of multiple diseases through a base of over 15,000 identical and non-identical twins.

Big data currently allow data scientists and companies to access an enormous amount of data (structured and unstructured) that can be brought together thanks to the power of artificial intelligence (AI).

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world. One of the current challenges is to predict the future presence and spread of the virus using all types of forms of big data.

There are reports of data use to curb the spread of different diseases through urban design. An historical event illustrates this notion: during a cholera outbreak in London in 1850, physician John Snow discovered, through data analysis, that the areas that were being served by a particular water pump were more affected than others. Shutting down that pump helped to control the pandemic (Pisano 2020). Another example of data use is what is currently known as the *15-minute city* approach (Paris En Commun and Milano 2020) that creates decentralised nodes of basic needs for the user (education, work, transportation, markets, green areas) in order to reduce the need for massive circulation of people within a city. Circumscribing a certain amount of people to a '15-minute radius,' would, in principle, reduce the spread of potential pathogens.

All these approaches, directly or indirectly, are using current data trends in order to determine future mechanisms to reduce and prevent the spread of a disease in cities (Pisano 2020).

Big Data and AI

Big data and algorithms are useful to gather and rapidly analyse large quantities of data, such as symptoms, underlying health conditions as well as location of risk patients and available hospitals. Mobile phone applications have proven to be efficient up to a certain degree to track symptoms and locate persons with special needs, while tracking the

Current Key Applications of Data Intelligence

China's approach to handling the coronavirus at a very early stage is a concrete example that has almost become a benchmark for the rest of the world. Particular actions were taken to tackle the epidemic using big data, notably online dissemination of information on patients, AI-assisted infection risk identification, temperature monitoring, online screening, AI-assisted radiological image interpretation and intervention recommendations; big data analytics for epidemic prevention and control, including predictive modelling and turning point projection; supercomputing for vaccine and drug development; telemedicine services; telecommuting and online education; drones deployed for crowd activity monitoring; IT security and growth of the 5G and internet-of-things devices use.

The cases of the Guanggu Fangcang and Tongji Hospitals, where cloud technology was used to create a 'smart hospital,' is an interesting application of data intelligence to speed up processes in the hospital and maximise safety and efficiency through online diagnosis (American College of Cardiology 2020).

The hospitals gathered data about patients in the cloud, provided guidance about treatment while making registration and the transferring of patients to the designated available block much faster. Additionally, 5G technology (and AI-enhanced lung imagery) allowed professionals to share a large number of images between hospitals in different cities, allowing other professionals to provide additional annotations that would ultimately improve and train the algorithms. Robots, equipped with cameras, temperature-screening



sensors and radars, were also used in the isolation areas to safeguard medical staff from infection (reducing the stress and strain on humans and the need of additional protective clothing).

Talent, Prevention and Prediction

Thanks to the current tools in data analytics, a Canadian company was able to track the virus and predict the countries where it would spread next. This software company is capable of tracking and predicting the spread of over 150 diseases around the world.

The natural language processing (NLP) and machine learning (ML) powered software combines the analysis from official public data provided by organisations like the Center for Disease Control and the World Health Organization. Interestingly, it also integrates less structured data, like commercial airplane circulation, insect and animal population statistics, weather data from satellites and local general and healthcare information. By combining these datasets, they were able to anticipate the spread of the disease based on the volume of travellers from Wuhan to Bangkok, Tokyo, Phuket, Hong Kong, Singapore and Seoul, cities where the infection rates had been growing.

Different data intelligence techniques and methods have been applied to determine the nature of the virus and predict, to the best extent possible, the health outcomes of patients.

A study performed in 2020 in Italy (Coccia 2020) has shown that acceleration of transmission of COVID-19 can be associated with different forms of air pollution. Cities that had more than 100 days of air pollution (PM10 or ozone) had a higher average of infected individuals (over 3,600) compared to cities with less than 100 days (over 1,000 infected).

A similar analysis – as a consequence of the incidence of winds – has been drawn between hinterland (2,200 infected individuals with 80 polluted days per year) versus coastal cities (940 infected cases with 90 polluted days per year).

A case of prediction has been developed using artificial neural network curve fitting techniques (Tamang et al. 2020), whereby using public World Health Organization data researchers were able to predict future trends in infection. These forecasting methods were able to present an intelligent model with simple calculations combining data from different countries.

Another example is the use of deep convolutional neural network (CNN) to detect COVID-19 using chest x-ray imagery. This model uses a machine learning system (deep learning) that trains a computer model to perform classification tasks directly from pictures, texts or sounds (Alazab et al. 2020).

Challenge of Future Prediction

With today's technology, companies should be able to predict a future pandemic, not only through the use of current models and data, but through different unstructured sources of datasets nourished by direct healthcare sources as well as indirect sources, from social media to weather or even pollution.

In view of the progress of the last few months, it is clear that the COVID-19 outbreak will serve as an example for companies dealing with data analytics. Existing data and classifications will be annotated and the algorithm refined with previous inaccuracies corrected, thereby integrating new datasets to increase precision and prediction capacities for the future.

Conflict of Interest

None. ■

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