Project Stories

PLATFORM TECHNOLOGY GIVES A BOOST TO AGENCIES RESPONDING TO THE PANDEMIC

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Topics: Disease Outbreaks, Modeling and Simulation, Public Health, Health Innovation, Data Analytics

Mitigating the spread of COVID-19 requires data and predictive analytics. MITRE Platforms give our government sponsors access to data and models that help combat COVID-19 and inform key decisions that reduce infection and fatality rates.

Governments around the world have implemented different interventions to control the spread of COVID-19. Some have worked better than others. Understanding how these interventions affect the disease's spread plays a pivotal role in making the right decisions to reduce its impact.

To take some of the guesswork out of their actions, public health officials and government decision-makers often turn to data and predictive analytics, including modeling and simulation. At MITRE, we deliver these capabilities through multiple specialized platforms that boost decision-makers' ability to understand and respond to pandemics. Platforms are web-based technologies that provide ways to tap into—and add to—existing knowledge to create reusable solutions for current and future challenges.

The MITRE Pandemic Analysis and Response Platform works to predict how disease morbidity and mortality would evolve under a variety of implementable pandemic control options using detailed information on population size and density, age, contact rate scenarios, the extent of social networks, and available healthcare resources.

While the platform has been built and applied using our experience with Ebola and recent work on COVID-19, the core technologies are flexible by design and

applicable to any pathogen passed through human to human contact.

Our specialized analytics offer an abstraction of a city, region, or entire country. Using algorithms to model the movements and interactions of populations, expert researchers can predict population behavior and simulate an infection and its spread under various sponsor courses of action to better understand how to respond.

A Force-Multiplier

In keeping with MITRE's mission to solve problems for a safer world, the team behind our Pandemic Analysis and Response Platform was not waiting for a worldwide outbreak of a deadly disease. They had already been at work modeling real and potential epidemics; that experience prepared them for these unprecedented times.

"The MITRE Pandemic Response and Analysis Platform serves as a force-multiplier for people needing data, predictive analytics, and modeling and simulation," says Jennifer Mathieu, lead for the platform. "It captures existing knowledge and lessons learned while creating a repository of capabilities to rapidly respond to sponsor needs."

"We started using and adapting our disease spread simulation models—from past research—back in January, that support COVID-19 response, including policy recommendations," explains Bahaa Fam, MITRE senior adviser. "Our models project trends in infection and mortality and clarify inflection points under a variety of potential local and national control strategies. These models can be used to quantify the impacts of policy and governmental actions."

"We published a paper early in March 2020, based on our modeling work, which illuminated the impact of concerted population contact rate reduction on disease spread. The paper suggested concrete policy and economic measures to reduce the spread and economic impact of the SARS2-COV2 pandemic in the United States."

Supporting the Nation's Pandemic Response

The MITRE Pandemic Response and Analysis Platform is a blend of numerous analytics. Among those analytics are capabilities to track COVID-19 non-pharmaceutical interventions (NPI), mortality, contact rate behavior, and local case growth behavior. It also includes analytics for predicting epidemic time of arrival

and disease spread, given various interventions at local (or military base), regional, and national levels.

"It all starts with the data and its quality and completeness when understanding NPI interventions by state," says Kunal Rambhia, one of MITRE's lead researchers for the COVID-19 Healthcare Coalition. "What was interesting to observe was the variability in the decision making, particularly with regards to reopening economies, schools, and travel.

"As we try to understand the dynamics of the outbreaks across the country, we need to be able to put together what actions governments took, how those actions affected population behavior, and what the outcomes were on transmission and mortality."

Being able to estimate how the national Case Fatality Ratio is evolving over time for different age groups with data lets us better understand how our nation's response to COVID-19 is affecting case outcomes.

"Stratification of the Case Fatality Ratio by age enables us to account for evolving case demographics, and ultimately gain insight into how our changing interventions are influencing mortality rate," notes Kristin Fitzgerald, a MITRE data scientist.

Modeling and Simulation

Aggregated mobility data provided to MITRE from Safegraph offers one-of-a-kind insights into population behavior and can be especially valuable when combined with other forms of information, such as case counts, business closures, or super-spreader events.

"We have found it useful in understanding timelines—such as what came first, behavior changes or business closures—correlation of behaviors with disease progression, and differences in behavior by locale," says Sean O'Neil, a MITRE technical fellow.

"Perhaps most important, we've found that coupling the Safegraph analytics with machine learning approaches, as well as detailed disease progression modeling, can provide unique, timely, and actionable predictions and insights regarding behaviors and controls to those responsible for policy and decisions relating to public health."

"We're also applying machine learning to determine which factors are important to

case growth and using the results to develop interactive models that will help decision-makers choose among actions to achieve better COVID-19 outcomes," adds Alex Brofos, a lead on the project.

Modeling and simulation allow decision-makers to compare multiple courses of action to mitigate the spread of the virus through non-pharmaceutical interventions (social distancing, masks, and hygiene) and pharmaceutical interventions (testing, therapeutics, and vaccines).

"These resources provide state- and county-level insight into the dynamics of COVID-19 spread. They also provide insight into the secondary effects of key decisions, such as adding hospital capacity or lifting interventions early, and how the fatality rate will change if hospitals become overwhelmed," says Steph Glasser, a MITRE chief engineer.

Because the coronavirus pandemic is a complex, evolving challenge, the community is still learning a lot about underlying concepts as the science improves with new evidence.

"We are also working with the government to increase plasma donation levels by, among other techniques, using our agent-based and systems dynamics simulation models for disease projection," Glasser adds.

"Decision-support models need to continually evolve to adequately represent the complex space and provide relevant decision options based on what is likely to happen," says Andreas Tolk, one of MITRE's leading experts in modeling and simulation.

Giving Sponsors A Head Start

Fam notes, "MITRE responded to the novel coronavirus outbreak quickly by helping to predict how fast an outbreak could spread with simulation models for disease and outbreak and recommending behavioral and economic actions to minimize the impact of the pandemic. With our newest models, we are able to employ data from each state to simulate and understand possible outcomes to mitigate the spread of the virus."

MITRE platforms have become a major asset in detecting patterns in the spread of the virus and devising strategies for rapid response.

"Through our platforms, we're sharing knowledge to give stakeholders and government the information they need to make informed decisions about COVID-19's spread—and using what we learn to help them make even better decisions going forward," Mathieu says. "We're also collaborating with the Social Integrity Platform to build technology to monitor and characterize dis/misinformation around COVID-19 and related therapeutics."

—by Aishia Caryn Freeman

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