CARES Act Project

NIIMBL® The National Institute for Innovation in Manufacturing Biopharmaceuticals

BUILDING MODELS TO OPTIMIZE COVID-19 TESTING STRATEGIES

DESIGNING A TEST KIT SUPPLY CHAIN IN RESPONSE TO COVID-19

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Type:
Academic Research Institution

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INDUSTRY NEED

When COVID-19 gripped the world in 2020, the U.S. faced three critical issues in its ability to test individuals for the disease. The first was identifying bottlenecks in the supply chain for polymerase chain reaction (PCR), antigen, and antibody test kits. The second was developing an appropriate test kit allocation strategy that would meet the demand for testing and optimize the limited availability of test kits and resources. The third was determining the right combination of PCR and antigen testing in congregate settings such as schools and nursing homes that would allow for continued activity and maintain health and safety. These deficiencies were contributing factors to early pandemic testing issues, such as lack of test kits and long wait times for results.

SOLUTION

Led by the North Carolina State University Poole College of Management, this project aimed to apply mathematical modeling, social listening, and interviews to develop tools that would help public officials predict test kit supply shortages before they became a problem, allocate a more accurate number of test kits to better meet demand within communities, and combine antigen and PCR testing methods in congregate settings to enhance screening protocols, identify infected individuals, and allow for activities to continue in a safer environment.

OUTCOME

The team uncovered insights that could help policymakers and community leaders predict and manage test kit supply shortages and develop testing protocols. For example, the team determined that widespread screening of individuals without symptoms using rapid antigen tests could help communities more accurately plan for test kit demand and alleviate test kit supply uncertainties while protecting public health. Antigen tests cost as little as $5, whereas PCR tests cost approximately $100. This lower cost would allow for more frequent antigen testing to overcome false negatives and potential inaccuracies. The team developed a comprehensive web dashboard to help school, state, and community leaders evaluate the cost and performance of antigen test-based screening protocols based on specific needs and population size. The model lets users define the testing timeline, frequency, and population size. It even lets users account for "exogenous shocks," which are infections introduced through contact outside of the test setting. To gain more insight into supply shortages, the team used machine learning to monitor Tweets and Google searches and found the data could accurately predict future supply shortages. In one example focused on pipettes, Twitter mentions and Google searches could predict large-scale shortages three to four weeks in the future. The models improved the ability to understand and forecast shortages of testing supplies.

> *"The NIIMBL project allowed us to assemble a team with diverse expertise in mathematical modeling, supply management, and biopharmaceutical manufacturing to collectively address a complex problem."*

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