Computer model helps Benin vaccinate more kids at lower cost

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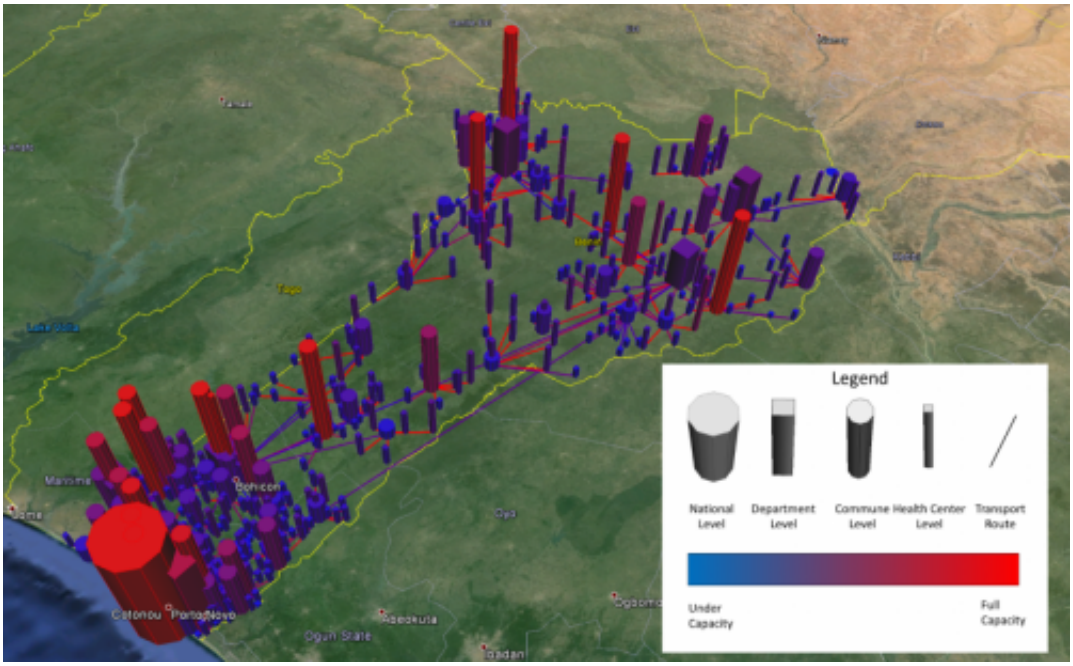

In Benin's simulation, multiple red columns and lines show the supply chain's storage and transport bottlenecks, where capacity may be inadequate for vaccines to continue flowing to their intended destinations. Credit: Shawn T. Brown, PhD, and Bruce Lee, MD, MPH

The HERMES Logistics Modeling Team, consisting of researchers from Pittsburgh Supercomputing Center (PSC), the University of Pittsburgh School of Engineering and the Johns Hopkins Bloomberg School of Public Health, have used HERMES, their modeling software, to help the Republic of Benin in West Africa determine how to bring more

lifesaving vaccines to its children. The team reports its findings this month in the journal *Vaccine*.

Results from the HERMES model have helped the country enact some initial changes in their vaccine delivery system, which may lead to further changes nationwide.

"The paper outlines our engagement with the Benin Ministry of Health in which we worked to choose among some key redesign options of their vaccine supply chain," says Shawn T. Brown, PhD, Director of Public Health Applications at PSC, Technical Lead of the HERMES team and first author. "It's a clear use of computational modeling and simulation to help a government figure out how to get the vaccines that are so desperately needed to every child they can."

The HERMES model also helped show the impact of adding the rotavirus vaccine to the nation's supply chain. Rotavirus is a major cause of infant mortality in low-income nations, killing nearly half a million children annually, with the highest death rates in Africa and South Asia.

"These are major policy decisions that could affect millions of lives," says Bruce Y. Lee, MD, MBA; Associate Professor of International Health and Director, Operations Research, International Vaccine Access Center, Johns Hopkins Bloomberg School of Public Health; Scientific Lead of the HERMES team; and co-author. "Our team's goal has been to develop state-of-the art computational technology to help such decision-making around the world."

The team used their HERMES (Highly Extensible Resource for Modeling Supply-chains) tool to evaluate different options of redesigning the Benin vaccine system being considered by the Benin Ministry of Health. These included maintaining the current national system; consolidating the nation's system of 80 "commune-level" supply

depots to a system of 34 "health-zone" depots; eliminating the commune level entirely; and splitting the seven current high-level "department" and "regional" stores into 12 new departments. The investigators also evaluated the effects of changing transportation routes.

The computational model favored the health zone approach along with changing transportation routes, which could save between $50,000 and $70,000 in initial expenses and $50,000 to $90,000 in annual costs compared with the other scenarios, while still reaching 99 to 100 percent of children. Through 2017, the improved plan would save Benin over $500,000 in total costs while improving vaccination rates and facilitating the rotavirus vaccine.

HERMES is a software platform that allows users to generate a detailed discrete event simulation model of any vaccine supply chain. This simulation model can serve as a "virtual laboratory" for policy makers, health officials, funders, investors, vaccine and other technology developers, manufacturers, distributors, logisticians and researchers to address a variety of questions in supplying vaccines as well as other health supplies.

With the support of the Agence de Médecine Préventive, which participated in all steps of this innovative project, the Benin Ministry of Health has launched a successful demonstration following the group's pre-publication recommendations. The nation is now considering scaling the new system to the entire country.

Provided by Pittsburgh Supercomputing Center