New COVID-19 vaccine must be kept ultra-cold; will require novel distribution network

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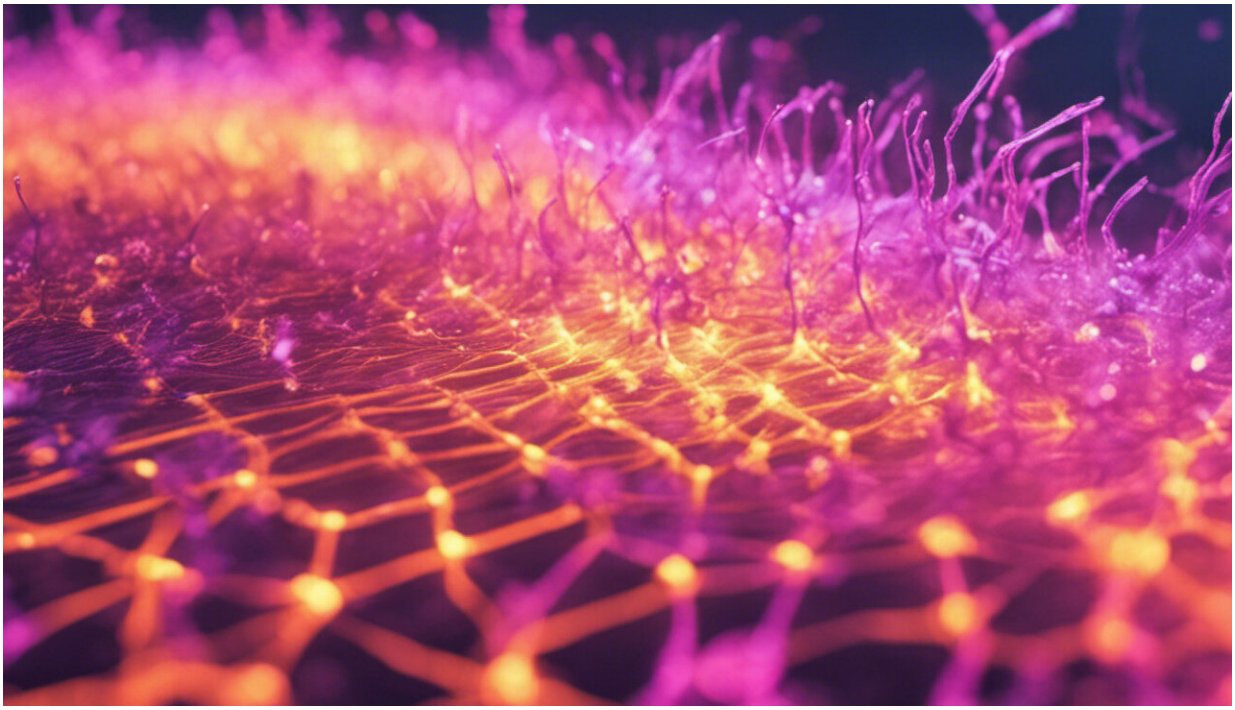

Credit: AI-generated image (disclaimer)

The cold, hard fact is: Pfizer blazed a trail in creating a touted COVID-19 vaccine, but now it must help to equally pioneer an unprecedented way to distribute the drug across the United States and the globe, says a supply chain expert at Washington University in St. Louis.

Delivering this breakthrough vaccine at steeply refrigerated temperatures necessitates "an almost brand-new distribution network and strategy," according to Lingxiu Dong, professor of operations and manufacturing management at Olin Business School.

Storing it will be no small task, either, no thanks to the vaccine's short shelf-life and a global dry-ice shortage that likely will require alternative methods.

"Pfizer has taken extraordinary steps in preparing the manufacturing and distribution of the COVID-19 vaccine," Dong said.

"Distribution turns out to be a more challenging task due to the ultra-cold temperature requirement: -75 degrees Celsius, equivalent to -103 degrees Fahrenheit—for storage and transportation."

That's reportedly 50 degrees colder than vaccines currently used in the U.S.

The overarching concern, she said, is preventing it from spoiling—keeping thousands upon thousands of doses refrigerated without moving them from storage place to storage place, from supply-chain hands to medical hands, until the path is firm and fast.

"Distributing the vaccine in large quantities to vast geographic areas while maintaining the required temperature consistently in the entire process requires an almost brand-new distribution network and strategy," Dong said. "The distribution should minimize the number of handlings of the delicate vaccine from the manufacturing site to where it gets administered to patients, because each 'touch' could increase spoilage risk. At this point, there are two storage solutions for Pfizer's COVID-19 vaccine. One is the ultra-low temperature freezer that can keep a large inventory of vaccines at -103 degrees Fahrenheit. The other is Pfizer's

thermal shipper box that uses dry ice to maintain the ultra-low temperature for 10 days and, after box-opening, would require dry ice replenishment every five days to store the vaccine for up to 15 days."

Pfizer has sold tens of millions of vaccine doses to China, the United Kingdom and other countries globally as well as 100 million to the United States, which has an option for 500 million more. In many cases, countries must construct—from the ground up—deep-freeze transportation and storage networks.

"Each storage method, as a storage solution for administration sites, has its weakness," Dong said. "The ultra-low temperature freezer can be expensive for small administration sites. The thermal shipper box's viability depends on whether the site can secure steady and reliable delivery of dry ice, which is currently in shortage. Given these challenges, a hub-and-spoke distribution network might offer a reasonable solution. The hubs are where vaccine stockpiles are kept in freezers, and the spokes are the administration sites that keep a small number of thermal boxes for temporary storage and receive frequent vaccine replenishment from the hubs. The hub-and-spoke structure can ensure vaccine availability at administration without imposing a heavy local storage burden (freezer or dry ice replenishment) and minimize vaccine wastage (vaccine expiration at the administration site)."

Various state health officials across the U.S. told CNN they were "shocked" when informed of the intricate "cold chain" required for the much-awaited vaccine, with such inoculations being a ray of hope amid a nine-month-plus pandemic that has afflicted 10 million Americans and killed roughly a quarter-million.

"Several factors are critical to the success of the vaccine distribution," Dong said. "First, the design of the distribution network directly affects its efficiency and responsiveness. Second, having timely information

about the supply-and-demand condition, and the system's inventory movement, is crucial to the hub-to-spoke replenishment and hub-to-hub transshipment decisions. Third, having the end-to-end visibility and traceability is essential to ensure the vaccine's safe distribution and administration," Dong said. "Fourth, vaccine distribution and administration require multiple parties' concerted effort: federal and state governments, manufacturers, logistics providers, local health care providers. Clear communications of the available resources, responsibilities and accountabilities are essential to the coordination's success. Finally, personnel should receive adequate training to handle and administer the new vaccine and be as ready as possible for the highly anticipated vaccine distribution."

Provided by Washington University in St. Louis