

Vaccine Distribution - The Logistics Challenge of a Lifetime

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The Quick Read:

- Developing a vaccine for a novel virus may be the easy part; distributing one or multiple temperature-sensitive doses to 7.8 billion people will be the real challenge.
- As little as a one-degree temperature variation in transport can cause a vaccine to spoil and be discarded; the WHO estimates 25-50% of vaccines are wasted annually, largely due to inappropriate temperature controls.
- Large parts of Africa, Asia and South America do not have cold chain networks suitable for the leading vaccine prospects, and some health care suppliers are already hoarding dry ice.

The world is racing to create an effective COVID vaccine in record time. While developing the vaccine isn't easy – it's *relatively* easy compared to the challenge of distributing the one-to-two required doses to 7.8 billion people. For some perspective, this is equivalent to delivering three times the number of iPhones, iPads, and Apple Watches ever sold... at the same time.

The Vaccine Cold Chain

An effective vaccines distribution strategy requires near perfection across the cold chain (the refrigerated supply chain). Orchestrating the billions of vaccines from manufacturing facilities, across various transportation modes, and to the final storage destination is no straightforward task. It becomes even more complicated when considering that two of the leading vaccine candidates (Moderna and Pfizer) require storage at -4 and -94 degrees Fahrenheit, respectively.

Vaccines are highly perishable products that must be kept at specific temperatures determined by each manufacturer. As little as a one-degree temperature variation can cause a vaccine to spoil, and a spoiled vaccine needs to be discarded. The World Health Organization estimates that 25-50% of vaccines produced annually are wasted, largely due to inappropriate temperature controls. While that loss ratio might be accepted during normal times, that simply won't suffice during a global pandemic.

“Analysis by Oxfam, a non-profit focused on reducing global poverty, found that even if the five leading vaccine candidates were approved, there would still not be enough for the majority of the population until 2022.”

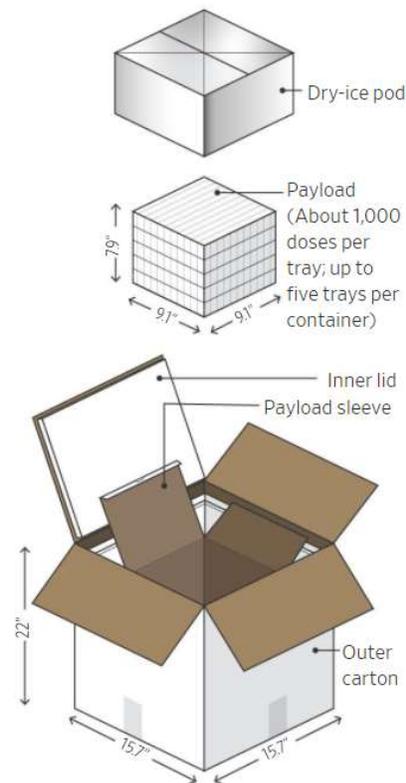
The Major Challenges

Ensuring consistent temperature management across the cold chain is a complex procedure that requires either specialized chilling equipment or precise packaging with fillers such as dry ice. Very few of the hospitals and pharmacies expected to be vaccination sites possess the specialized freezers required for storage. To address this cold chain challenge, logistics companies are building massive mobile cold-storage units dubbed "freezer farms" and healthcare suppliers are hoarding dry ice like its Beanie Babies in the 90s.

While the problem of distribution issues should ultimately be resolved in advanced economies, developing countries are a different story. Regions with particularly warm climates and those with limited existing cold chain infrastructure pose additional hurdles. Currently, there are large parts of Africa, Asia, and South America that do not have cold chain networks suitable for the leading vaccine prospects. Special steps will be required to ensure vaccine distribution can even reach the global population in these locations, which increases the time to achieve global immunity.

Conclusion

Society realized early in the COVID pandemic how complicated it was to distribute even non-perishables such as PPE and toilet paper. Those challenges will pale in comparison to the logistical nightmare the cold chain will face once a vaccine becomes available. Priority will go to the places with existing freezer infrastructure that can quickly reach large numbers of the most vulnerable. An analysis by Oxfam, a non-profit focused on reducing global poverty, found that even if the five leading vaccine candidates were approved, there would still not be enough for the majority of the population until 2022. That said, this is a global problem, with global implications, and the world's top scientists with massive resources have been devoted to it. In the meantime, continue to stay positive, test negative, and get your flu shot, too!



Note: $-70^{\circ}\text{C} = -94^{\circ}\text{F}$.
Source: Pfizer

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