

Cool innovations for vaccine transportation and storage

Maintaining temperatures on and off the grid

Keeping heat-sensitive vaccines and other drugs at the right temperature is crucial yet often difficult in areas with limited or no electrical power. In response to this challenge, a group of public- and private-sector partners is working with project Optimize, a collaboration between the World Health Organization (WHO) and PATH, to evaluate a range of transportation and storage containers for heat-sensitive drugs and vaccines that operate in environments with or without access to reliable power.

Stationary passive coolers

Commune-level passive cooling in Vietnam

Currently in Vietnam, not all commune health centers have the capacity to provide vaccine cold storage for a full month. Vaccines are generally brought in for one- or two-day immunization sessions as part of the monthly national immunization strategy. However, it is important for certain vaccines (such as hepatitis B) to be available throughout the month so that babies can receive necessary vaccinations at birth.

With support from Optimize, the National Expanded Programme on Immunization is evaluating the appropriateness of new small-volume (about 3 to 4 liters) passive cooling devices, creating capacity to store a small number of vaccines all month at the communes. These devices provide approximately one week of cooling on one “charge” of ice and use regular ice available in the community rather than ice packs. In this way, cooling can be provided with no requirement for a refrigerator or even an onsite energy supply.

It is anticipated that these coolers will improve on-time delivery of hepatitis B birth dose. The intervention does not require electrical power onsite and does not disrupt the current monthly immunization day system, which is working very well. More information about these devices is available from [SAVSU Technologies](#).

Mobile passive coolers

Passive cooling for vaccine transport in Tunisia

To safely transport new vaccines, Tunisia’s Expanded Programme on Immunization is working with Optimize to evaluate phase-change material (PCM) packs as a possible passive cooling storage alternative to ice packs. Similar to ice, solidly frozen PCMs hold more cooling power than when in the melted or liquid phase. PCM packs are ideal because they can freeze at a vaccine-safe temperature (e.g., 5°C) and can have direct contact with freeze-sensitive vaccines, allowing the entire box area to be used for vaccine. Traditional cold boxes can substitute PCM packs for ice packs and provide adequate cooling for the work day in the heat of the Sahara. More information about PCM vaccine carriers is available from [Dometic](#).

Insulated containers on Senegal’s moving warehouses

The Ministry of Health in Senegal is piloting a “moving warehouse” approach. Rather than requiring health post staff to pick up vaccines, antiretrovirals, and malaria and tuberculosis medications along with associated supplies from a district center, two trucks serve as moving warehouses and distribute supplies from the regional level to health posts in all five districts of



Innovations such as large, insulated containers (left) and small-volume passive cooling devices (right) keep vaccines cool during transport/storage with limited reliance on electricity.

the Saint-Louis region. Integral to the moving warehouse concept is the use of the [Aircontainer](#) Bigbox large, rolling, insulated containers to transport necessary drugs and vaccines. With a capacity of 161 liters, the volume of one rolling container is equivalent to eight long-range traditional cold boxes, which saves space and makes it easier to handle larger volumes of bulky single-dose vaccines. The containers are cooled by PCMs that have been chilled in a refrigerator at safe temperatures for a specified time period. PCM panels are placed in the container, and vaccines can be loaded in direct contact with all inside surfaces of the rolling container. Currently, trucks equipped with these containers are able to keep vaccines at proper temperatures for a work week while on the road. Also, in areas where roads are poor, moving warehouses equipped with passive containers have a lower maintenance burden and higher reliability when compared to insulated trucks with active refrigeration.

Active refrigeration

Ice-lined refrigerators in Senegal

Power problems that occur throughout the developing world, including in Senegal, make it challenging to cool vaccines and heat-sensitive drugs with electric refrigerators. In this type of intermittent power environment, conventional practices often rely on diesel generators to back up unreliable grid electricity. However, generators are costly, difficult to maintain, create noise and air pollution, and are subject to fuel supply disruptions and diversions.

In Senegal's Saint-Louis region, a more reliable and energy-efficient solution for vaccine storage is being demonstrated: a super long-life holdover ice-lined refrigerator, [Sure Chill®](#), by True Energy. This refrigerator can provide stability in intermittent power conditions, and the use of [Sure Chill®](#) technology, with longer than average holdover times, can eliminate the need for backup generators if grid electricity provides at least eight hours of power on average per day. The [Sure Chill®](#) can operate with just four hours of electricity per day and provide more than ten days of holdover (in case of total absence of electricity) to maintain acceptable vaccine temperatures, even in warmer climates. Particularly in settings where electricity is unreliable, the [Sure Chill®](#) is a safer, more reliable choice for vaccine storage than domestic refrigerators.

Domestic refrigerator study in Tunisia

Many countries, including the United States, are using untested, unmonitored, domestic-style refrigerators for storing vaccine and reporting significant losses due to poor temperature control. The WHO Performance, Quality and Safety (PQS) program has established equipment standards and testing protocols for vaccine refrigerators, including electric, ice-lined, gas/kerosene, and solar-powered models. WHO recommends the purchase of PQS-prequalified refrigerators.

However, many countries elect to purchase locally available refrigerators because they are less expensive, are quickly available, employ front-opening doors, and are familiar to local service technicians. Unfortunately, few of these domestic-type refrigerators are sufficiently monitored to ensure safe vaccine temperatures. Research has indicated that domestic refrigerators have widely varying temperature performance and can expose vaccines to freezing temperatures and rapid warm-up after power cuts. The widespread practice of domestic refrigerator use warrants better temperature monitoring to identify problem refrigerators before they damage vaccines.

In Tunisia, Optimize is working with Centre Technique des Industries Mécaniques et Electriques, a government-sponsored laboratory, to use WHO PQS protocols to test typical domestic refrigerators that have been used for vaccine storage or are being considered for future purchases. Domestic refrigerators in use are also being monitored. Evaluation results will help Tunisian decision-makers assess the risk of using domestic refrigerators, and laboratory testing of new models will identify potential risks as well as help to inform solutions for maintaining acceptable temperature control. If no suitable refrigerator or solutions can be identified, decision-makers have evidence to make the case to develop improved models in country or to purchase WHO PQS-prequalified refrigerators. The demonstration in Tunisia is intended to convey to all countries using domestic refrigerators that first, they should all be continuously monitored in use; and second, they should be tested and their performance confirmed before procurement.

Project partners

- Aircontainer Package System Sweden AB, Dometic Sàrl, SAVSU, True Energy
- Senegal: Ministry of Health
- Tunisia: Centre Technique des Industries Mécaniques et Electriques, Ministry of Health
- Vietnam: National Expanded Programme on Immunization, Ministry of Health

The mention of specific companies or of certain manufacturers' products does not imply that they are endorsed or recommended by the World Health Organization or PATH in preference to similar products that are not mentioned.

July 2012