



EVIDENCE BRIEF

Unplugged and keeping cool—testing off-grid vaccine storage solutions in Vietnam

Project Optimize, a collaboration between the World Health Organization (WHO) and PATH, has been working in several countries to demonstrate new technologies and system innovations for the vaccine supply chain. The main objective was to help countries envision solutions for managing larger and more costly volumes of vaccines as immunization programs grow in the future.

The need for off-grid cooling options

Keeping heat-sensitive vaccines at the right temperature is crucial yet often difficult in areas with limited or no electrical power. In Vietnam, the electric grid is extensive, yet many small communities throughout the country experience frequent power outages. These power outages stress both refrigerators and health workers in their efforts to keep vaccines at the manufacturers' recommended temperature between 2°C and 8°C. An assessment performed in 2009 by Optimize also indicated that funding for electricity at small health centers was sometimes not available. As a result, refrigerators were often unplugged between immunization days, which is hard on the refrigerator mechanism. One compelling reason to consider options for cooling vaccine without electricity is the first dose of hepatitis B vaccine, which must be given within 24 hours of birth to most effectively prevent the transmission of the disease from mother to child. In some small health centers without electricity, this important vaccine is simply not available when it is needed.

New technologies to meet the challenge

The Optimize team, in collaboration with the Vietnam National Expanded Programme on Immunization (NEPI), evaluated two technologies to respond to this challenge. One was a direct-drive solar refrigerator appropriate for use at the district health center. Direct-drive solar refrigerators differ from traditional solar refrigerators in that they store energy without the use of batteries to cool



PATH/Le Thanh Hai

True Energy BLF 100 DC Sure Chill® vaccine refrigerator

the refrigerator during the night and cloudy days when the sun is not providing electricity. The large battery systems in traditional solar refrigerator systems require careful maintenance and reach the end of their life within three to five years. They are expensive, and appropriate replacement batteries are often not available in low-income countries. For these reasons, solar vaccine refrigerator programs often “die” with the battery. New direct-drive solar vaccine refrigerators eliminate the battery by using frozen ice or other phase change material to store energy while the sun is shining and continue to provide cooling after the sun sets.

The BLF 100 DC Sure Chill® vaccine refrigerator manufactured by True Energy was selected for use in the demonstration. Laboratory testing showed that it can successfully maintain a temperature in the range of 4°C to 7°C, and it can maintain that temperature without solar energy for more than ten days. This was important because at one of the project sites in the north of Vietnam, winter weather includes long periods of cloudy weather. This device also had adequate capacity for the vaccine volume at district health centers, and it was prequalified by WHO as meeting the global standard for vaccine refrigerator performance, quality, and safety.



PATH/Nguyen Phu Cuong

Savsu Technologies Nano-Q vaccine cold box

The other cooling technology Optimize demonstrated in Vietnam was a passive cooling device for vaccine storage. Everyone is familiar with passive coolers—we use them to store drinks during a summer picnic! They are passive because there is no active cooling mechanism—they use ice or other frozen material in an insulated container to provide cooling over a limited time. In vaccine logistics, passive coolers have long been used for vaccine transportation. In Vietnam we wanted to demonstrate the use of a device for long-term storage, replacing the use of electric or gas refrigerators in small health centers.

Nano-Q is a new device from US-based Savsu Technologies that uses state-of-the-art insulation materials and a unique configuration designed to maintain appropriate temperatures for vaccine storage without electricity. Optimize chose Nano-Q because it can provide up to seven days of cooling at an outside temperature of 32°C before the ice needs replacing, and it uses normal ice available for purchase close to the health centers. As it operates without electricity, Nano-Q has no electric or moving parts and requires no regular maintenance to keep it running.

Off-grid cooling in action

Project Optimize monitored two True Energy refrigerators for one year starting in May 2011 and 12 Nano-Q vaccine storage units for eight months starting in September 2011.

Researchers monitored the temperature of all the devices and the electric generation and consumption of the solar refrigerators. We also interviewed users about their experience with the equipment.

Both technologies had advantages as well as drawbacks, as shown in Table 1.

Table 1. Findings from cooling technology demonstrations

	Sure Chill® Solar Refrigerator	Nano-Q Passive Cooler
Advantages	<ul style="list-style-type: none"> Freedom from worry when power is out Very steady temperature performance Excellent performance during extended cloudy periods 	<ul style="list-style-type: none"> Freedom from worry when power is out Easy temperature monitoring Easy maintenance Temperature stays between 2°C and 8°C when outside air is above 20°C
Drawbacks	<ul style="list-style-type: none"> Excessive condensation and moisture in the refrigerator Experience of controller failure Lack of technical knowledge in the community for repairs High investment cost 	<ul style="list-style-type: none"> Ice is difficult to find and expensive in winter in central and northern areas Temperature fell below 2°C in winter in central and northern areas High investment cost

Equipment status at study completion

True Energy has improved the Sure Chill® refrigerator technology as a result of the findings in Vietnam. A total of 26 modifications were made in order to improve cooling efficiency, ease operation for installers and users, and increase robustness. These changes respond to the problems with condensation and other issues seen during the demonstration in Vietnam. This has highlighted the importance of early field trials of new refrigerator technology to refine devices for operation in real-life settings. True Energy has provided new models of the Sure Chill® to NEPI to replace the early models that were demonstrated.

The Nano-Q boxes situated in the south of Vietnam will continue to be used. NEPI discontinued the use of boxes in the central and northern regions during the demonstration when temperatures dropped below 2°C in the vaccine compartment. Large-scale purchase and distribution of additional Nano-Q devices in Vietnam's immunization program in the short term is unlikely due to the high capital investment needed.

The lessons learned in the demonstration of these technologies will be useful for other country programs considering either direct-drive solar refrigerators or passive cooling for long-term storage of vaccines.

FOR MORE INFORMATION

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