



## Contents

First solar direct-drive refrigerator receives WHO prequalification . . . . .	1
WHO develops a process to determine programmatic suitability of vaccines for prequalification . . . . .	3
Toward a global framework for e-health information systems . . . . .	4
Modeling tools under development. . . . .	6
Supply chain assessment reveals opportunities for Vietnam . . . . .	9
Vaccine vial monitor use, policy, and practices in four regions. . . . .	10
Your phone rings; it's the freezer calling. . . . .	11
New in print. . . . .	13
Announcements . . . . .	13

## First solar direct-drive refrigerator receives WHO prequalification

by Janos Maté, SolarChill Project, and Steve McCarney, PATH

On March 18, 2010, the [World Health Organization \(WHO\)](#) prequalified its first solar direct-drive vaccine refrigerator (Vestfrost model MKSO44). Ten years in the making, the [SolarChill](#) vaccine cooler operates with a compressor powered directly from sunlight. Instead of storing electrical energy in a battery, the refrigerator stores thermal energy in ice, and a thermostat maintains the temperature between the required 2° to 8°C for vaccine storage. In low-sun situations or when power is completely disrupted, the insulated “ice battery” maintains acceptable temperatures for up to five days. An intelligent fan enhances the convection circulation of the cold air and is operated by a small rechargeable battery, which is recharged by solar power.

The current generation of SolarChill is prequalified for 20° to 32°C ambient temperatures. However, in field tests the units have operated under lower and higher ambient temperatures ranges of 10° to 42°C.

The direct current compressor and “ice battery” design makes SolarChill a groundbreaking technology. The lead batteries used in most solar refrigerators are expensive, short-lived (especially in hot climates), toxic to produce, and difficult to properly dispose of in remote regions. They represent a major obstacle to the uptake of solar technology in developing countries. A recent survey of solar-powered vaccine refrigerator performance found that over 60% of equipment failures are related to battery systems (McCarney, unpublished data, 2010). It is not a question of if a battery will fail, rather when. Batteries can fail due to improper design, poor installation, over use of the refrigerator, lack of maintenance, and delay of repairs. Programs relying on batteries must plan for and fund the inevitable repair and replacement costs of batteries.

### First to meet the solar challenge

Project Optimize is taking action to improve the success of all solar-powered vaccine refrigeration. Efforts include documenting criteria for successful solar programs, reducing the need for active refrigeration, increasing battery life, and replacing batteries with thermal energy storage. In 2008 Project Optimize leveled a challenge at industry to develop direct-drive solar vaccine refrigerators. Five proposals were received, and three were awarded support for WHO prequalification test costs including the Vestfrost SolarChill.

To prequalify the technology, WHO established two new categories for refrigerators in its [performance, quality, and safety \(PQS\) standards](#). Project Optimize has actively supported the development of both the WHO PQS E03 RF05.2 for battery-free solar direct-drive refrigerators or combined refrigerator/icepack freezers and the WHO PQS E03 RF06.1 for solar direct-drive refrigerators or combined refrigerator/icepack freezers that require a small ancillary rechargeable battery for control purposes. The SolarChill (19.5 liter capacity) is the first to fit the latter category.

### Technology that does not heat the planet

For the [SolarChill partnership](#), which was launched in 2001, gaining WHO prequalification marks a significant milestone in the effort to produce an environmentally friendly, battery-free, affordable solar refrigerator. Prior to the establishment of the new PQS categories, all prequalified WHO refrigerators using compressors included hydro-fluorocarbons (HFCs) as refrigerants. HFCs are bioaccumulative pollutants that contribute to ozone depletion and climate change. Concerns about atmospheric concentrations of HFCs and their significant role in climate change have made them less than ideal technologies for health systems. Instead of using fluorocarbons, SolarChill uses “[GreenFreeze](#)” hydrocarbon technology developed by Greenpeace in 1993 for blowing insulation foam and for the refrigerant, which makes them safe for the ozone layer and the climate.

The SolarChill Project partners<sup>1</sup> have no commercial interest in the project. Their sole mandate is to develop the public domain technology, make it freely available to interested manufacturers worldwide, and promote its uptake internationally. The SolarChill vaccine cooler is currently available through the large Danish appliance manufacturer [Vestfrost](#).

In 2010, the SolarChill partnership launched large-scale demonstration and technology transfer projects in Colombia and Kenya with PATH taking the lead role in implementing the demonstration projects in both countries. These projects are funded by the Global Environment Facility through the World Bank.

The WHO prequalification of SolarChill enables low- and middle-income countries that require earth-friendly, less-costly, and reliable solar refrigeration solutions to specify SolarChill technologies for their vaccination programs.

In a related development, the SolarChill Project is testing a larger model of direct-drive solar refrigerator, operating on the same principles, for the purpose of domestic and light commercial food refrigeration. The SolarChill Project thus bridges health, development, and environmental concerns through an innovative technology.

To learn more about the SolarChill refrigerator and the partnership that made it happen, visit [www.solarchill.org](http://www.solarchill.org).

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1. The SolarChill Project partner organizations are the Danish Technological Institute, the German Government Development Agency, Greenpeace International, PATH, United Nations Environment Programme, the United Nations Children's Fund, WHO, and the World Bank. Please see [www.solarchill.org](http://www.solarchill.org) “Contacts” for the names and contact information of individual representatives.

## WHO develops a process to determine programmatic suitability of vaccines for prequalification

by Rudi Eggers, WHO/EPI, and Nora Dellepiane, WHO/QSS

The World Health Organization (WHO) recently convened a working group to propose a new process for assessing the programmatic suitability of vaccines for prequalification. The need for a new process has been driven by the emergence of unique vaccine presentations such as relatively large packed volumes, prefilled syringes that do not include an autodisable feature, injection device materials that require nonstandard disposal methods, suboptimal thermostability profiles, and fully liquid low-multidose vials without preservative. These unique vaccine presentations require a more standardized approach for determining programmatic suitability.

Like the current process the new process would involve assessing characteristics such as vaccine presentations, labeling, information provided on package inserts, and packaging. The new process, however, explicitly defines the characteristics that determine programmatic suitability and the process for assessing compliance with these characteristics. Important vaccine characteristics would be organized into four groups: mandatory, critical, preferred, and in need of formal review.

- 1. Mandatory characteristics:** Compliance would be compulsory at the time of application for WHO prequalification (screening step) and must be unconditionally met prior to comprehensive review of the product summary file (PSF).
- 2. Critical characteristics:** Compliance with critical characteristics would also be compulsory. However, if upon screening the data the Prequalification (PQ) Secretariat identifies a deviation from a critical characteristic value, then the PQ Secretariat would inform the manufacturer and refer the question for review by a standing committee composed of professionals with programmatic background and expertise to be established by WHO for the purpose. It is proposed to name this committee the Programmatic Suitability for WHO Prequalification (PSPQ) Standing Committee. The PSPQ Standing Committee could then review the information and make a recommendation, with or without consultation with the manufacturer and additional technical experts, to proceed with a comprehensive review of the PSF or to request validation of the acceptability of noncompliant characteristics through additional research.
- 3. Preferred characteristics:** Compliance would be expected. However, deviations could be tolerated (for thermostability and materials characteristics, compliance is encouraged but not expected).
- 4. Unique, novel, and innovative characteristics:** Characteristics not otherwise specified as mandatory, critical, or preferred would be identified by the PQ Secretariat and would be referred to the PSPQ Standing Committee for review, discussion, and recommendation.

Reviews of programmatic suitability characteristics are proposed to take place at two points in the process. First, when the application letter is submitted for initial evaluation of the vaccine candidate for prequalification, and second, when the PSF is screened. Once the PSF is found to be suitable for evaluation, the prequalification process includes a review of the production process and quality control procedures, review of clinical data, testing of consistency of lots, and a joint WHO and national regulatory authority site visit to the manufacturing facilities.

Once the evaluation is complete and if the vaccine is found to be acceptable, in principle, for purchase, it is considered prequalified and is posted on the WHO website. The prequalification status is valid for a period that varies between two and five years depending on the experience with the vaccine in the market and the performance of the manufacturer. Random lot testing (once per year) provides independent monitoring of continued compliance with the tender specifications. A review of complaints and reports of adverse events following immunization also allows WHO to monitor the performance of the vaccine and detect potential problems and unexpected changes in the characteristics of the vaccine.

Once prequalified, United Nations (UN) purchasing agencies have assurance that the vaccine meets WHO standards for quality, safety, and efficacy of vaccines and that the vaccine is appropriate for the intended population and at the relevant immunization schedules. It is the responsibility of the prequalification program to ensure that the candidate vaccines meet WHO recommendations and the needs of the program which are reflected in the UN tender specifications.

The tender specifications state the desired features of the vaccines including the stability profile, use of vaccine vial monitors on the vaccine vial, use of temperature monitoring devices during shipment, preferred presentation, labeling and packaging information, packaging volumes, shipment conditions, etc.

The proposed PSPQ process will replace a more iterative process that relied solely on individual expert inputs from the WHO PQ Secretariat; the Expanded Program on Immunization team; and the director of the WHO Department of Immunizations, Vaccines, and Biologicals. The proposed PSPQ process will be further circulated for comments and final endorsement by the Expert Committee on Biological Standardization before being formally posted on the WHO website.

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## **Toward a global framework for e-health information systems**

*by David Lubinski and Jan Grevendonk, PATH*

Improving health outcomes through strengthened platforms and systems has emerged as a guiding principle of donors and multilateral agencies. A key building block for this effort will be the development of integrated information systems to support a variety of products and programs.

In the summer of 2008, the Rockefeller Foundation sponsored a conference series bringing together more than 200 leaders from developing countries, the global health care community, technology, finance, policy, and government. The Foundation called for the development of a global e-health architecture to ensure that these systems both comply with global standards and meet the needs of their users.

In order to meet the needs of health workers across programs and countries, global and in-country stakeholders must identify common functional requirements that translate these needs into a language that can be used by developers to deliver appropriate information system solutions.

In this context, the Rockefeller Foundation awarded PATH a grant to develop a catalytic approach to health information system strengthening through the Collaborative Requirements Development Methodology (CRDM). The CRDM consists of three sets of activities: (1) a landscape analysis of best practices and research, (2) identification and validation of functional requirements, and (3) standardized documentation of the functional requirements and processes in non-technical language.

Ensuring the continuous availability of vaccines, pharmaceuticals, and medical supplies is core to any health system strengthening effort. Improving logistics management also represents a common challenge for many countries and programs. For these reasons, CRDM was first applied to the development of requirements for Logistics Management Information Systems (LMIS).

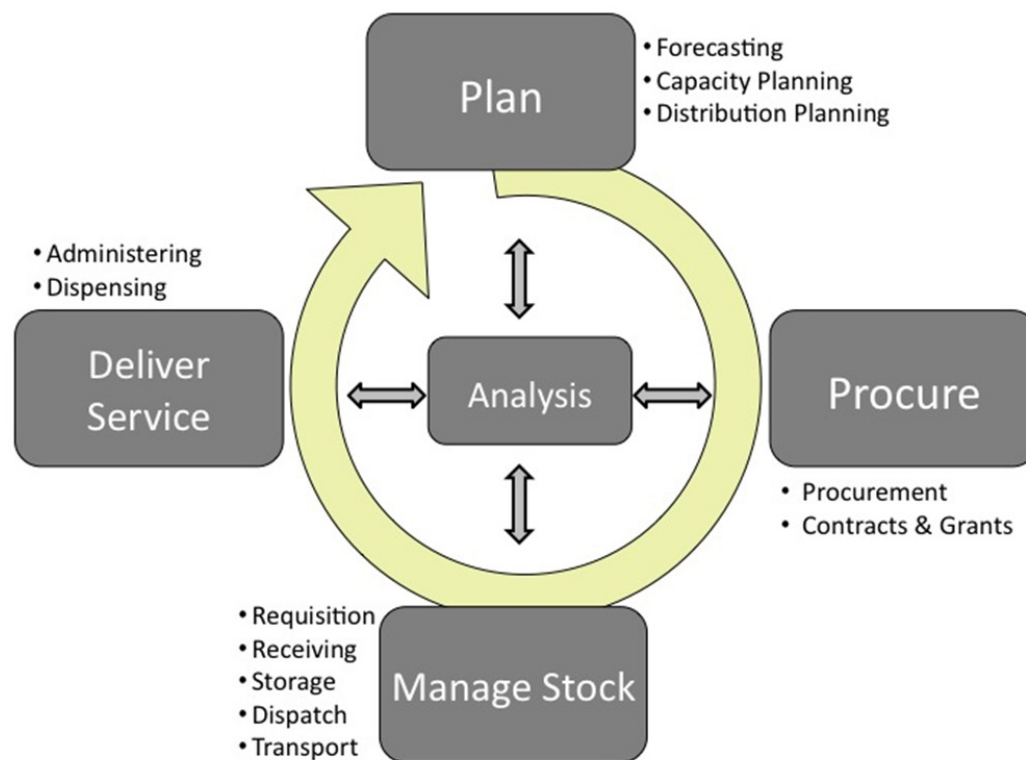
The goal of LMIS is to ensure that adequate quantity and quality of vaccines, essential medicines, and supplies are always available to meet patient demand. In order to do this, the LMIS must be capable of:

1. Capturing accurate routine administration, dispensing, and consumption data.
2. Real-time end-to-end logistics management from the point of origin to service-delivery point.
3. Demand forecasting, capacity planning, and modeling based on consumption.

The application of CRDM requires rich collaboration from stakeholders, subject matter experts, and users to identify the core business processes relevant to logistics and describe their associated activities and workflow.

Between October 2009 and April 2010, partners engaged in this collaborative effort and designed a model for LMIS, listing each business process and its information requirements. Four countries (Vietnam, Kenya, Senegal, and Rwanda) validated the model and provided feedback, which the working group used to refine and augment the original model. The resulting map of the business processes involved in LMIS is displayed in Figure 1.

**Figure 1:** LMIS Functional Process Model



For each business process shown above, there is a clear objective (e.g., the objective of receiving is to “receive verified quantity and quality of goods into store and determine need for remedial action when necessary”).

There is also a set of statements that describe the functionality that an information system would need to provide in order to support each business process. To continue with our example of business process (receiving) there are several areas of functionality required. For example, the system needs to provide notification of arrival, it needs to provide the information necessary to prepare storage space, and it needs to show the results of an inspection upon arrival, among other things. Each of these functions, in turn, require inputs and outputs that are easy to understand and use on a regular basis.

Together, the requirements for logistics management information systems provide the beginnings of an architectural framework that crosses national boundaries and provides a strong base for developing rational, easy-to-use systems for storing, retrieving, and using information for better decision-making within the health system.

PATH and the [Health Metrics Network \(HMN\)](#) are now reviewing these processes and requirements with a broader group of stakeholders which will lead to additional feedback and refinement. Following this review phase, documents describing the common requirements for LMIS will be released to the global health community for LMIS-strengthening efforts in countries. These common requirements can be used to identify gaps in current systems, as terms of reference for the development or acquisition of new systems, or at a very basic level, to help document standard operating procedures or develop training materials. The methodology may also be applied to other domains in the health system.

The results of this work will be published and made available through WHO and the HMN. Countries, donors, and software developers working on health care related information systems will then have a strong, validated base to build upon—be it assessing if a preexisting information system is right for them or developing a customized system to meet their unique needs.

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## Modeling tools under development

*by Tessa Tan-Torres, WHO; Linda Allain, USAID | DELIVER PROJECT; Bruce Lee, University of Pittsburgh; and Carol Levin, PATH*

If developing countries are to meet their populations’ health needs, they must ensure that their supply chains are able to cope with the increased quantities, volumes, and cost of supplies. To help decision-makers understand the possible health and/or cost impacts of various supply chain design options, four different health commodity supply chain modeling initiatives are underway: (1) the logistics module of the Unified Health Model (UHM) sponsored by the United Nations (UN) Interagency Working Group on Costing, (2) the 2020 Supply Chain Model (USAID | DELIVER PROJECT), (3) the Vaccine Modeling Initiative (VMI) through the University of Pittsburgh, and (4) the vaccine logistics model at PATH-World Health Organization (WHO) with project Optimize. With the desire to demystify these four different yet complementary initiatives, this article explains the purpose, application, and expectations for each model.

**The UHM** is a tool for national planners to facilitate their strategic planning process. The model can be used to generate scenarios that display the financial requirements and expected mortality impact arising from alternative combinations of strategies. Its modules relate to key parts of the health system and

major diseases and conditions, with particular focus on the health-related [millennium development goals](#). The logistics module covers scenarios related to health logistics and supply chain. This module is being developed by LLamasoft using a simplified version of their “Supply Chain Guru” software package. The specific goal for this module is to take a forecast of commodity and logistic equipment requirements and basic product information and, taking into account the country context generate a supply chain network, logistics metrics, financial metrics, and measures of network service. Individual modules of the UHM will be piloted in third quarter 2010. The full model will be piloted in 2011 and then will be publicly available with full documentation and opportunities for training.

**The 2020 Supply Chain Model** is an activity undertaken by the [USAID | DELIVER PROJECT](#) in collaboration with other partners. The model will work from a “country view” in terms of morbidity patterns and the products required to meet treatment and prevention of prevailing diseases, as well as product needs for other public health initiatives such as family planning services, in the years 2020 to 2025. The 2020 model is designed to help policymakers accurately visualize and understand the most likely and possible situations facing them in ten years and make informed decisions about how to design their supply chains to meet those needs. The model should be available in late June or early July 2010 with plans for dissemination in the fall of 2010.

**The VMI**, funded by the Bill & Melinda Gates Foundation and based at the University of Pittsburgh, aims to develop computer models and simulations to better understand vaccine development, distribution, and administration. The VMI is developing “HERMES,” an interactive computer software tool that can rapidly create a simulation model of nearly any vaccine supply chain to the level of detail specified by the user (ranging from very simple representations to an extensively detailed representation of each vaccine unit, person, storage container, transport device, etc.). This software tool will be freely available and will include a graphical user interface which will allow users to input different characteristics of the supply chain and vaccines. Within minutes HERMES can construct a simulation model of the supply chain and the vaccines flowing through the chain. HERMES will be able to either stand alone or dock with other models such as disease models to simulate the resulting effects on the items of interest to the end user (e.g., disease control, personnel allocation, inventory management, ordering policies, budgetary impact, etc.). The tool is currently in the verification and validation stage using data from Niger’s Expanded Program on Immunization. VMI expects to release the software tool in 2011, along with documentation, training, and support to interested decision-makers.

**Optimize** is developing a vaccine supply chain logistic model in both Excel and ARENA®, a logistics simulation software. The model is designed to provide a visual presentation of the transport, cold chain, and warehouse components of the vaccines and injections supply chain and provide a platform for simulating changes and evaluating the associated costs. The model can be applied to any country setting, capturing the multiple functions and levels of the vaccine logistic supply chain. For example, in Vietnam, Optimize is piloting the introduction of small-volume passive cooling devices at the commune level. By modeling the costs and health impacts of this change and comparing it to baseline costs and impacts, government collaborators will be able to understand comparative costs and benefits of the proposed change, inform decisions and policies relating to the change, and engage in future vaccine supply chain system designs. Optimize is also supporting the other modeling initiatives through direct collaboration and participation on technical advisory groups.

#### **How do the models compare?**

Above all, each of these modeling tools is being created to help decision-makers make informed choices about supply chain design and management options. The models can answer difficult questions, such

as: What are the trade-offs between storage and warehousing for health commodities? What is the cost impact of expanding the volume of drugs and vaccines in the supply chain? What is the cost impact of different supply chain design scenarios that will improve access to health commodities in remote areas? A summary of the models and their differentiating characteristics is provided in Table 1. Although there is considerable overlap among the models, they each serve a slightly different purpose, and their developers are working together to ensure that unnecessary repetition or reinvention is avoided.

**Table 1:** Summary of the four models

Model	Scope	Target countries	Procurement	Measured outputs	Software	Developers
<b>UHM</b>	All health commodities, including vaccines	Will be made publicly available	Yes	Cost and health impact	Simplified "Supply Chain Guru" by LLamasoft	UN Interagency Working Group on Costing and LLamasoft
<b>2020 Supply Chain Model</b>	All health commodities, including vaccines	Developing countries	Yes	Cost, resource requirements, and system performance	Modified "Supply Chain Guru" by LLamasoft	USAID   DELIVER PROJECT
<b>VMI's HERMES</b>	Currently focused on vaccines and their accessories but can incorporate any product (e.g., medications)	Software tool that can be used to rapidly construct any supply chain in any country	Yes	Cost, health impact, and system performance (i.e., coverage, wastage, stock-outs, inventory levels, etc.). Outputs are customizable by the end-user	Custom designed (developed in C++) with a customized graphical user interface	University of Pittsburgh and Pittsburgh Supercomputing Center
<b>Optimize Supply Chain Model</b>	Vaccines and temperature-sensitive drugs	Limited to project partners	No	Cost and system performance (i.e., coverage, wastage, stock-outs, etc.)	Microsoft Excel and ARENA®	Optimize, a WHO-PATH collaboration

Together, these four modeling initiatives provide countries systematic and complementary approaches to answer key questions about immunization and health systems for the future. To learn more about one of the modeling tools, please contact the organization directly:

- Tessa Tan-Torres, WHO
- Linda Allain, USAID | DELIVER PROJECT
- Bruce Lee, University of Pittsburgh
- Carol Levin, PATH

## Supply chain assessment reveals opportunities for Vietnam

by Nguyen Tuyet Nga and Joanie Robertson, PATH, and Nguyen Van Cuong, NIHE

When Vietnam's National Expanded Program on Immunization (NEPI) and Optimize agreed to explore novel public-sector supply chain solutions for Vietnam, they started with an assessment of the current immunization supply chain system. The four-part assessment completed in March 2010 included one of the first large-scale uses of the [Effective Vaccine Management Assessment Tool](#); an evaluation of commune-level cooling and storage practices; an assessment of the information system used to track vaccines and immunization coverage; and a study describing fee-based immunization practices, supply chains, and structures. Together, these assessments have revealed opportunities for Vietnam to develop, evaluate, and monitor an optimal public-sector supply chain for the future.

Vietnam already enjoys [high \(93%\) coverage](#) through monthly immunization sessions. Cold chain capacity appears to be adequate, temperature-monitoring practices are consistently good, and infrastructure is in good condition. At the commune level vaccines are efficiently distributed and used throughout an impressively broad network of health centers. The information system that tracks and monitors immunization coverage and vaccines is increasingly being computerized at provincial and regional levels, and dedicated health workers maintain good records despite the labor involved in transferring numbers across multiple paper ledgers and reports. However, there remains some ambiguity about how to calculate the coverage target. There is high interest in exploring different technologies to make it more efficient.

System enhancements should focus on several opportunities that surfaced in the assessments. For example, vaccine arrival procedures and stock management can be standardized, and good distribution management practices can be replicated throughout the system. At the commune level, hepatitis B vaccine birth-dose delivery is compromised because vaccines are not regularly stored there. This is in part because refrigeration technologies are not always appropriate for these settings where electricity can be intermittent and budgets for electric bills competes with other funding needs. An ideal technology at this level would be relatively small volume, require low or no energy consumption, would not rely on grid electricity, would be affordable to purchase and maintain, and be easy to use. There also may be an opportunity to explore controlled temperature storage of hepatitis B vaccine outside the cold chain.

Efforts to enhance the immunization information system must attempt to reduce the burden of reporting on health care workers while simultaneously providing them more support and training. Good information systems must improve the quality, accuracy, and timely availability of information for stock management and immunization coverage, which then informs decisions at all levels. Experience with and interest in information technology is high, indicating that the country is ready to explore a more robust information system.

Efforts to model the costs and efficiency of an optimal supply chain system in Vietnam are underway, and baseline figures have been calculated. Now the partners will agree on the next phase of work, exploring the impact of potential new management approaches and technologies on the system, using the computer model to simulate changes and measure effects. In this way Vietnam and other countries can relatively quickly and easily test ideas for preparing cold chain systems for future demands.

Download the [full report](#) of Phase I assessments in Vietnam.

## Vaccine vial monitor use, policy, and practices in four regions

by Julie Milstien, independent consultant

While the benefits of using [vaccine vial monitors \(VVMs\)](#) in immunization programs are widely known, a recently completed study of VVM use and availability shows that their use is still not universal.



The vaccine vial monitor is a small sticker that adheres to the label or the cap of a vaccine vial. The inner square is made of heat-sensitive material that changes color as the vaccine is exposed to heat letting health workers know whether the vaccine can be safely used for immunization.

Photo: Wendy Stone

By synthesizing information from a number of sources, the study estimated that approximately 82% of the doses used for routine immunization in the Eastern Mediterranean region come with VVMs. The figure is about 84% in the African region, 56% in the Southeast Asian region, and 30% among developing countries in the Western Pacific region.<sup>1</sup>

The availability of VVMs depends largely on how the vaccine is procured. Countries using the United Nations-based procurement system tend to have VVMs on all vaccines used for routine immunization programs. Countries that procure their own vaccines directly from manufacturers or use a mixed sourcing system are likely to have a mix of products, and if they use VVMs at all, are most likely to have them on the oral polio vaccine. Most countries that produce their own vaccines do not use VVMs. Notable exceptions are India and Indonesia; both countries require VVMs on all domestically produced vaccine.

The report provides several recommendations to improve VVM availability including the following.

- Work with countries in the Eastern Mediterranean and Western Pacific regions to specify VVMs for all vaccines as part of their procurement requirements, whether the vaccine is being procured directly from external or domestic manufacturers or being sourced by other donors. Help countries that have specified VVMs as a requirement ensure that manufacturers include them.
- In cases where domestically manufactured vaccines are not prequalified by WHO, it may be necessary to convene a policy group to consider the implications of using VVMs on these vaccines including the type of VVM, oversight and enforcement issues, and financing concerns.

The study also considered results of in-depth reviews of policies and practices in eight countries, revealing a range of opportunities for improving and maximizing the impact of VVM use on program performance. For example, few countries are successfully using the VVM as a management tool (e.g., using the VVMs to decide which vaccines to use first or monitoring VVM color changes at each level of the supply chain), training is not systematically available at all levels of the health system, and there is widespread confusion about how to use VVMs with the [multidose vial policy](#).

To improve correct VVM use, several recommendations were made, including the following:

- Display visual reminders of correct VVM use and the multidose vial policy at all places where vaccinations are given.

1. VVM non-use in this region is heavily influenced by large countries that produce their vaccines domestically (e.g., China and Vietnam).

- Ensure training gaps, particularly among vaccinators, are addressed through systematic fixed-site training sessions or by supervision and on-the-job training.
- Use vaccine administration records to record the VVM stage on receipt at each level.
- Enhance supervision practices to ensure proper implementation of VVM practices such as recording the VVM stage, employing the multidose vial policy, prioritizing vaccines with VVMs that are starting to change color, correctly handling and discarding vaccines with VVMs that have reached their endpoint, and monitoring wastage.

With increased availability and proper use, VVMs can become a springboard for improving vaccine management practices, improving documentation of vaccines at each stage, ensuring efficient use of vaccines, avoiding stockouts and loss that result from improper storage, and ensuring that every dose given has not been damaged by heat.

For a copy of the report, please send an email to [who.optimize@path.org](mailto:who.optimize@path.org).

## Your phone rings; it's the freezer calling

by Olivier Ronveaux, WHO, and Mojtaba Haghgou, Vaccine Management Consultant

Maintaining required temperatures in vaccine refrigerators and freezers is one of the more thankless tasks of a cold chain manager as it requires painstaking manual recording of the temperature of each piece of equipment twice daily. Despite the monotony, temperature monitoring is a crucial task, especially in central stores at the national level where millions of doses of costly vaccines are at stake. A 2004 study of vaccine freezing in Indonesia, for example, found that freezing temperatures were recorded in 74% of shipments. Without careful temperature monitoring, accidental freezing or overheating of certain vaccines can reduce their potency to levels that render them ineffective against disease.

Several countries, among them Sudan and Iran, have found a way to automate the temperature monitoring system saving both time and money while increasing the accuracy and reliability of the monitoring system. While Sudan is a bit smaller in population than Iran, the two countries have a similarly sized number of surviving infants (1,086,000 in Sudan and 1,300,000 in Iran) and handled an almost identical number of doses of vaccines in 2007/2008 (about 108.8 million doses).

**Figure 1:** Gas-type temperature sensor



Photo: Mojtaba Haghgou

Sudan automated its temperature recording system with financial and technical support from the World Health Organization (WHO) Regional Office for the Eastern Mediterranean (EMRO) in 2007. A United Kingdom-based company was contracted for the design, assembly, and installation of the system which cost about £52,000 at the time.

The system includes a network of gas-type temperature sensors (Figure 1) in each cold and freezer room that measures the internal temperature and transmits it wirelessly via a transmitter installed on the roof of each cold and freezer room to a hub. The hub is connected to a computer for saving data. The store manager can also view the data on a monitor in his office (Figure 2). When temperatures exceed 10°C or fall below 0°C, an alarm system sounds a siren in the store and calls the mobile phones of the store staff and the Expanded Programme on Immunization (EPI) manager. The system also sends a short message service

**Figure 2:** Monitor with temperature data

Photo: Mojtaba Haghgou

(SMS) text to the mobile phones providing information about the specific cold or freezer room and its internal temperature at the time of breach. The system has functioned continuously since February 2007 without interruption or malfunction. A manual system is maintained for backup purposes and is kept on file.

Iran's system is older (2005) and perhaps more impressive because it was manufactured, designed, assembled, installed, and maintained entirely by local companies.

Although the cost of the system is unknown, it is likely to be the less expensive of the two systems since it involved no international travel or foreign labor costs. The system is similar to the Sudanese system with the following differences: local products and labor, the connection between the temperature monitor and the modem is wired (not wireless), the connection between the modem and the computer is wireless, and the temperature sensors are digital, rather than gas type.

EPI staff members from many other countries in the region have already toured Sudan to learn about its system, and there is great interest globally in replicating the concept. Since 2007, WHO has established specifications for performance, quality, and safety (PQS) for temperature monitoring systems and protocols for testing such systems. To support decision-making, Optimize is working to establish minimum criteria under which countries should consider installing automatic temperature recording systems. The type of recommended system will depend on the size of the stores, the number of vaccine doses handled per year, and the importance and location of the store.

Download a copy of a recent Optimize [report on temperature monitoring systems](#) in Sudan and Iran.

## New in print

### Beyond the cold chain

In Mali, vaccinators transported oral polio vaccine in carriers with and without ice packs. None of the vials showed heat damage.

[\[read more\]](#)\*

\*Published in Vaccine. Subscription or purchase required for full article.

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## Announcements

- [Immunization Practices Advisory Committee](#) meets for the first time on June 29 to 30 at WHO.
- [Vaccine Technology III Conference](#) will be held on June 6 to 11 in Nuevo Vallarta, Mexico.
- The global meeting on [New and Underused Vaccine Introduction](#) will take place on June 23 to 25 in Montreux, Switzerland.
- [Request for proposals](#): WHO released a request for proposals for the management and ongoing improvement of the TechNet website. This RFP is now closed.

**OPTIMIZE**

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