

Temperature monitoring for vaccine quality

A crucial link in the cold chain

One of the core functions of the vaccine supply chain is to keep vaccine products properly refrigerated along every step in their journey. While simple in theory, maintaining proper temperatures for products that can tolerate neither excessive heat nor cold is difficult in practice—especially in places with extremely hot or cold climates, unreliable connections to electricity, and weak transportation infrastructure. Temperature monitoring, then, is a critical tool that managers use to assess vaccine handling quality, detect malfunctioning equipment, and prevent temperature fluctuations that can negatively impact vaccine potency and safety.

SMS-based temperature alarm system in Albania

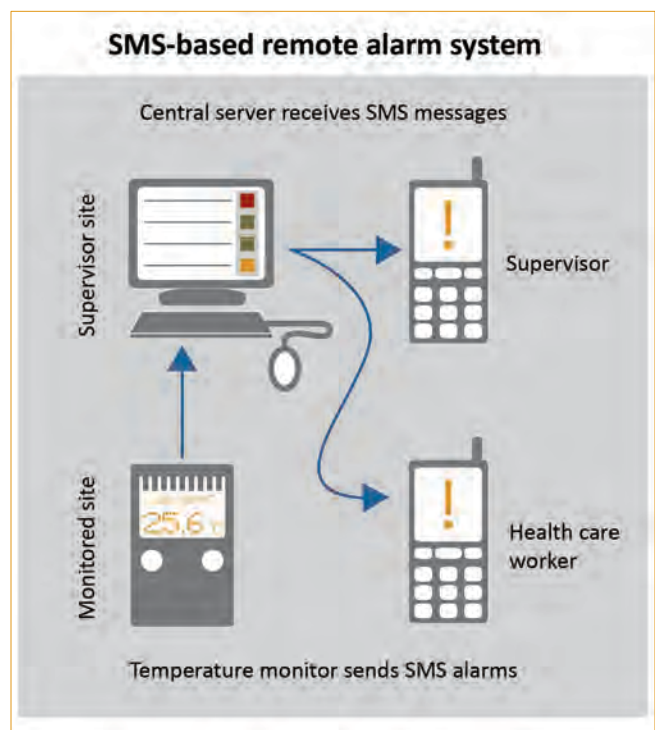
In Albania, standard thermometers have been replaced with 30-day recording devices with visual alarms. Alarms are typically triggered after 10 consecutive hours over 8°C or 60 consecutive minutes under -0.5°C , as per World Health Organization standards. The recording devices are used in most health centers where vaccines are stored. However, when an alarm is activated, health workers cannot respond during non-working hours when they cannot see the alarm, and without supervisor assistance, they cannot always provide necessary follow-up.

In 2011, the Albanian Ministry of Health, in collaboration with project Optimize, installed a short message service (SMS, or text message)-based system that monitored and logged temperature conditions in peripheral cold chain equipment.¹ The aim was to assess whether these remote alarm systems would facilitate better vaccine and cold chain management than non-connected temperature monitors.

Twenty-four storage locations in Albania's Shkodra District were equipped with sensors, monitors, and SMS gateways. When an alarm is activated, an SMS text message is sent to a central server that then sends a notification to health workers and supervisors in charge of the storage location. Once the problem has been addressed, its status is reported back to the central server.

More than 130 alarm incidents were detected in 10 months, and the system demonstrated certain managerial benefits for the Albanian cold chain:

- Supervisors phoned health workers or storekeepers in 41% of incidents to confirm detection of the problem and assisted in taking appropriate follow-up measures in 15% of these incidents.
- Procedural compliance by health workers has increased due to the knowledge that supervisors are automatically informed of temperature excursions.



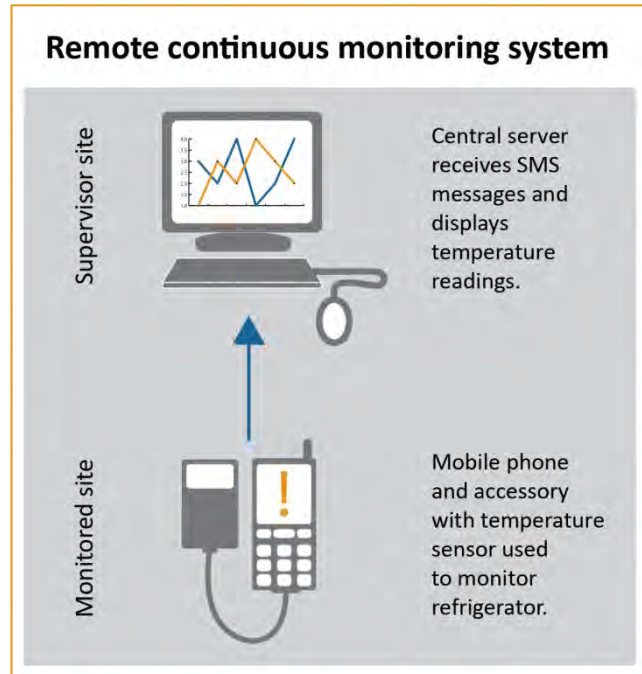
- A permanent record has been maintained centrally on the performance of each refrigerator, which allows district supervisors to track equipment failure rates and promptly replace equipment where needed.

In focus group discussions, nurses and Expanded Programme on Immunization supervisors reported that the technology was beneficial for their work. However, while the study highlighted some qualitative benefits of the technology, it did not detect any case in which remote monitoring saved a vaccine from freezing or excessive temperature exposure. A positive cost-benefit case was therefore not clearly made.

Continuous temperature monitoring using mobile phones

Apart from sending alarms, mobile phones could also be used to transmit frequent temperature measurements in refrigerators to a central server. Optimize tested one such system, FoneAstra, to assess whether this capability would allow program management to manage cold chain equipment in a more informed and systematic way.

To test the technology, FoneAstra devices were installed at six sites in Albania. Temperature probes were placed inside equipment with the device and mobile phone mounted externally. The FoneAstra device samples the connected temperature sensors every few minutes and aggregates these data. At regular intervals, it sends detailed temperature logs to a central server via SMS. For instance, the system could be configured to query sensors every 15 minutes and send detailed temperature reports every 12 hours. All the data received on the server, including temperature reports and alarm notifications, are stored in a database and can be easily viewed using a standard web browser.



While the scale of this intervention has not enabled a systematic analysis of the outcomes, it appears that gaining access to this kind of information does help program managers to evaluate the quality of cold chain equipment and to follow up accordingly.

Next steps

Both of the studies in Albania relied on experimental technology that is not ready for scale-up. The same concept is now being tested by the ministry of health and Optimize in Senegal, with Beyond Wireless, a commercial provider of remote temperature monitoring services. For the technology to be widely scalable, low-cost devices would need to become available. Berlinger & Co. has already announced the launch of a new version of their temperature monitor (Fridge-tag®) in late 2012, which could be integrated into a remote temperature monitoring system. Further evidence of the benefits of this system would be required.

Project partners

- Albanian Institute of Public Health
- Berlinger & Co. AG and Elpro Services Inc., makers of the Fridge-tag® temperature monitor
- University of Washington Computer Science and Engineering Department

¹ PATH. *Assessment of a Remote Alarm System for Vaccine Storage in Albania*. Seattle: PATH; 2011. Available at: www.path.org/publications/detail.php?i=2058.