Best Practices on Temperature Sensor Placement in Vaccine Refrigerators and Freezers

This white paper teaches users the best practices for training their team members on the do’s and don’ts of automatic temperature monitoring devices for medical monitoring uses, focusing on vaccine storage in accordance to CDC and VFC regulations and standards.

February 11, 2015

Written By: Dave Ruede | Edited By: Diane Deng | For Inquiries: marketing@temperaturealert.com
Introduction

With the US Center for Disease Control's (CDC) Vaccine for Children (VFC) temperature monitoring requirements making their way into many pharmaceutical regulatory body requirements, many pharmacies and medical practices are contemplating purchasing automatic temperature monitoring devices such as data loggers and devices that provides real time data logging and alert messages or alarms when temperatures exceed specified ranges. And these devices can automatically generate digital temperature logs, graphs and reports compliant with regulatory requirements, replacing manual logs in some cases.

Choosing the optimal solution is the first thing, implementation is the second and just as important. But who reads the manual any more? We've all used thermometers all of our lives, so what's different here? And even if the person who selected the device or system is knowledgeable about best practices, other team members particularly those responsible for physical installation may not be, leading to suboptimal temperature control and operation.

So what's so hard about putting a temperature sensor in a refrigerator or freezer? After all, it's a thermometer and we've all used them for many years, and besides, the thermometers we use when we're ill are either Red or Blue for various orifices. Best try not to get them confused! Unfortunately our experience with thermometers may not be useful for vaccine protection.

The CDC has spent a lot of time, money and effort to address the issue of sensor placement after studying best practices. The CDC’s 2014 VFC Guidelines address many common mistakes in temperature monitoring sensor placement and establishes best practices for VFC providers. These guidelines are being adopted by pharmacy and medical practice regulatory bodies for vaccines and other medications that require refrigeration.
Best Practices

So what happens if you don’t follow best practices? Sometimes not much, other times confusing data, and still other times potential problems. Take the case of a before and after installation. Initially a glycol vial buffered digital sensor was placed on the top shelf of a refrigerator near the cold air outlet (below). Temperature readings from Sensor Cloud show an average between 35°F and 36°F with lows approaching 30°F and highs near 42°F. The CDC’s VFC guidelines call for a range of 35°F to 46°F (2°C to 8°C). This installation is below the CDC minimum approximately 40% of the time. If the temperatures were any colder freezing of the vaccine is very likely.

The installation employed a propylene glycol vial buffered temperature sensor, which is recommended by the CDC.

Pictured sensor vial placement is not ideal according to the CDC guidelines. This vial is not protected from and too close to the cold air inlet airflow.

Figures 1 & 2: CDC Website Resource: Self Training
Left Image Link, Toolkit: Right Image Link

Figure 3: Initial Sensor Placement
(Temperature@lert Image)
After discussion with the installer, the glycol buffered sensor was moved forward and to the side of the shelf. Temperature averages moved between 36°F and 37°F with lows near 33°F and highs near 41°F. This change decreases the risk of freezing, which is where optimization was needed.

There’s a relatively wide range of temperatures (30°F to 41°F) due to compressor cycling in Figure 4.

The sensor’s buffer vial is not shielded by the bin like the medication vials and it is exposed directly to the cold air outlet airflow regions. These temperature readings likely do not reflect the temperatures to which most of the refrigerator’s contents are exposed to.

Note the low temperatures are below CDC guidelines.

This placement reduces the chance of freezing vaccines because it more closely mimics medication temperatures. It is farther away from the cold air outlet and is less likely to expose medications to potentially damaging higher temperatures.

The vial is still not located inside bins with the medication vials as, which is recommended by the CDC. This needs to be corrected.
Temperatures are maintained between 33°F and 40°F, closer to CDC VFC guidelines of 35°F to 46°F.

The low, 33°F temperature is below CDC guideline of 35°F but not below freezing (32°F).

Figure 6: Improved Sensor Placement Graph
(Temperature@lert Image)

The CDC's VFC Tool Kit is very helpful in describing how to optimize temperature sensor placement and configuration. Here are some images and comments to help in the process of optimizing placement and performance.

CDC VFC recommends sensors be located in the middle shelf inside a medication bin to better represent the average temperatures of all medications.

Avoid sensor placement on the top shelf which is typically the location of the cold air outlet is generally colder than lower shelves while the compressor is running.

Figure 7: Ideal buffered temperature sensor placement is inside bin on the middle shelf.
Best Practices on Temperature Sensor Placement in Vaccine Refrigerators and Freezers

**Figure 8**: Strategically placed water filled bottles help keep cold air from directly blowing on temperature sensitive medications while reducing the loss of cold air when the door is opened.

Place water filled bottles on the top shelf, at least near the rear to diffuse the cold air inlet and buffer cold temperatures when the door is opened.

Placing water bottles in space not used for medications displaces air and reduces the amount of cold air lost when the door is opened. The cold water filled bottles also help cool incoming, warm room air after the door is closed.

Larger water filled bottles are best but small personal size water filled bottles are fine if that's all the space available.

**Figure 9**: CDC VFC drawing of best practices for vaccine storage.

The door is **not** recommended for medication storage; temperatures there are not as well controlled. Personal sized water filled bottles fit well here, especially in smaller refrigerators.

Raising the refrigerator temperature so that the average temperature is around 40°F while max and min temperatures are between 35°F to 46°F (2°C to 8°C) is recommended. Check logs regularly to make adjustments if needed.

A prominent “DO NOT UNPLUG” sign is recommended. Even better, a plug secured to the outlet can help insure accidental unplugging and damaged medications.

*Note: Figures 7, 8 & 9 images from CDC Safe Vaccine Storage Guidelines and related documents – Links: Figures 7 & 8, Figure 9*
Using an automatic temperature monitoring device can help maintain regulatory required temperature logs. Alerts when temperatures approach or exceed CDC guidelines are needed, devices that send e-mail, text, and phone call alerts can help prevent loss of very expensive medications. Fault-tolerant cellular technology based devices deploying Sensor Cloud computing data collection, reporting, and alerting fill this requirement well.

Temperature@rt's Cellular and ZPoint product offerings linked to the company's Sensor Cloud dashboard provides a cost-effective and fault-tolerant solution for organizations of all sizes. Products and services can help bring medications and vaccine distributors, pharmacies, medical practices, clinics, and hospitals into compliance with minimum training or effort. For information about Temperature@rt's Cellular and Sensor Cloud offerings, visit our website at http://www.temperaturealert.com/ or call us at +1-866-524-3540.