

Remote Temperature Monitoring

Protecting Vaccines & Driving Data
for Improved Immunization Systems & Outcomes

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Vaccines save lives...

...yet an unknown number of kids every year get damaged, ineffective vaccines.

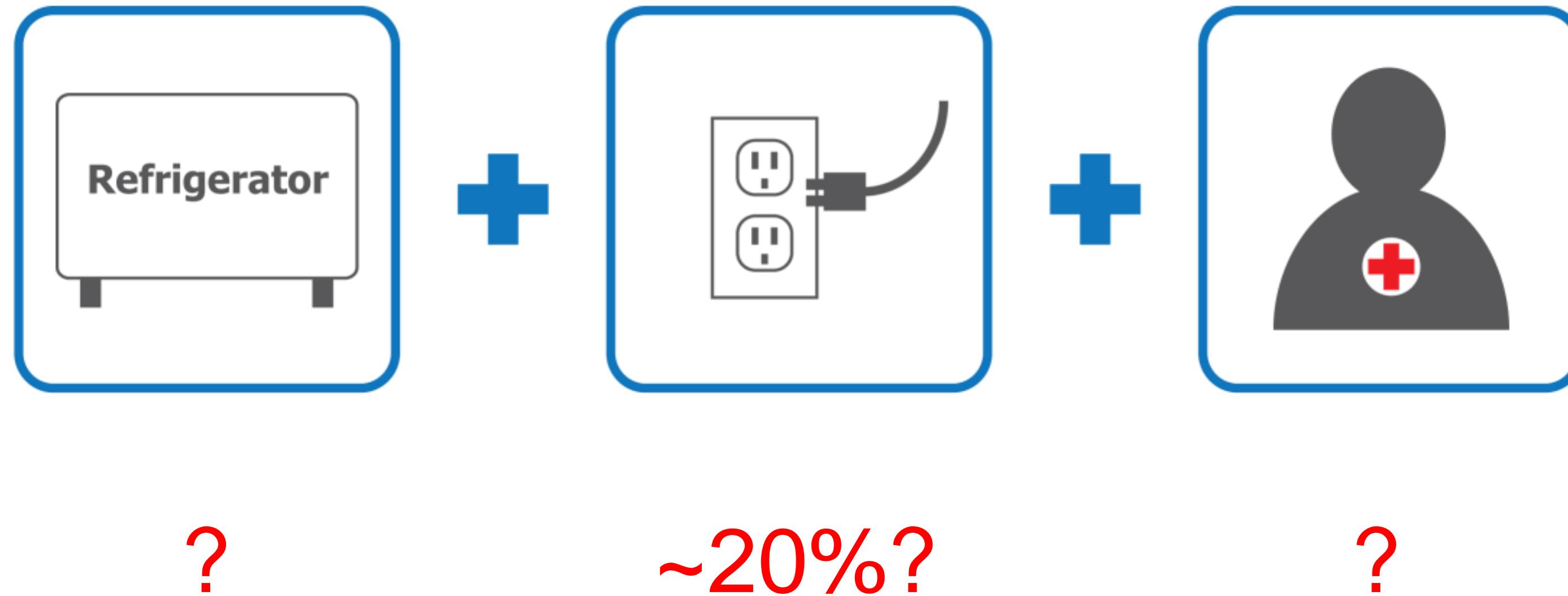
Vaccine doses must be stored between **2°C and 8°C**, but vaccine fridges in rural clinics often **fail**.

Unreliable equipment, frequent power outages, poor fridge management, and a lack of maintenance all lead to **temperature excursions**.

Temperature excursions damage vaccines. And **damaged vaccines do not protect kids**.



Causes of Temperature Excursions in Fridges



No Visibility into the Vaccine Cold Chain Management System

Département		Nom de l'institution		Marque et type de réfrig.																																		
Commune		Personne responsable		Energie																																		
Mois	Année	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31						
Tous les réfrigérateurs	Température Matin				1°	2°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°				
	Température Après-midi				1°	2°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°	1°			
Panne de réfrigérateur	Heure																																					
	Température				2°	3°	2°	2°	3°																													
Gaz	Réparation																																					
	Nouvelle bonbonne																																					
	Dégivrage et nettoyage du réfrigérateur																																					
	Maintenance du réfrigérateur																																					
Témoin : (V) Vert, (J) Jaune, (R) Rouge																																						
Nettoyage du panneau																																						

1

A nurse sees that a vaccine fridge is running hot. She logs the dangerous temperature by hand during the day. She has no idea if the vaccines are



2

The nurse tells the regional technician about the fridge. Without any real data and with limited resources, the technician has no way to diagnose the problem or repair it remotely.



3

The health systems manager can't advocate for a new fridge without evidence. She does not replace the fridge until next year. She stops sending vaccines to the remote clinic with no functioning



4

A child who received a damaged vaccine from the clinic with a failing fridge contracts measles, leaving many children vulnerable to the disease.

Protecting Vaccines: The ColdTrace System

The ColdTrace System has 3 Core Components:

ColdTrace Sensor Device



- The ColdTrace sensor device sends **alerts via SMS (text message) and email** when fridge temperatures get **too hot** or **too cold**

Data Analytics Dashboard



- Secure, cloud-based dashboard that allows remote access to **real-time temperature data**
- **Integrates into** existing LMIS systems (VIMs)
- Provides **customizable analytics** and **report-generating tools** to track equipment performance

Standard Operating Procedures (SOPs)



- SOPs for nurses, maintenance technicians, regional supervisors, and ministries of health for **effective cold chain system management**

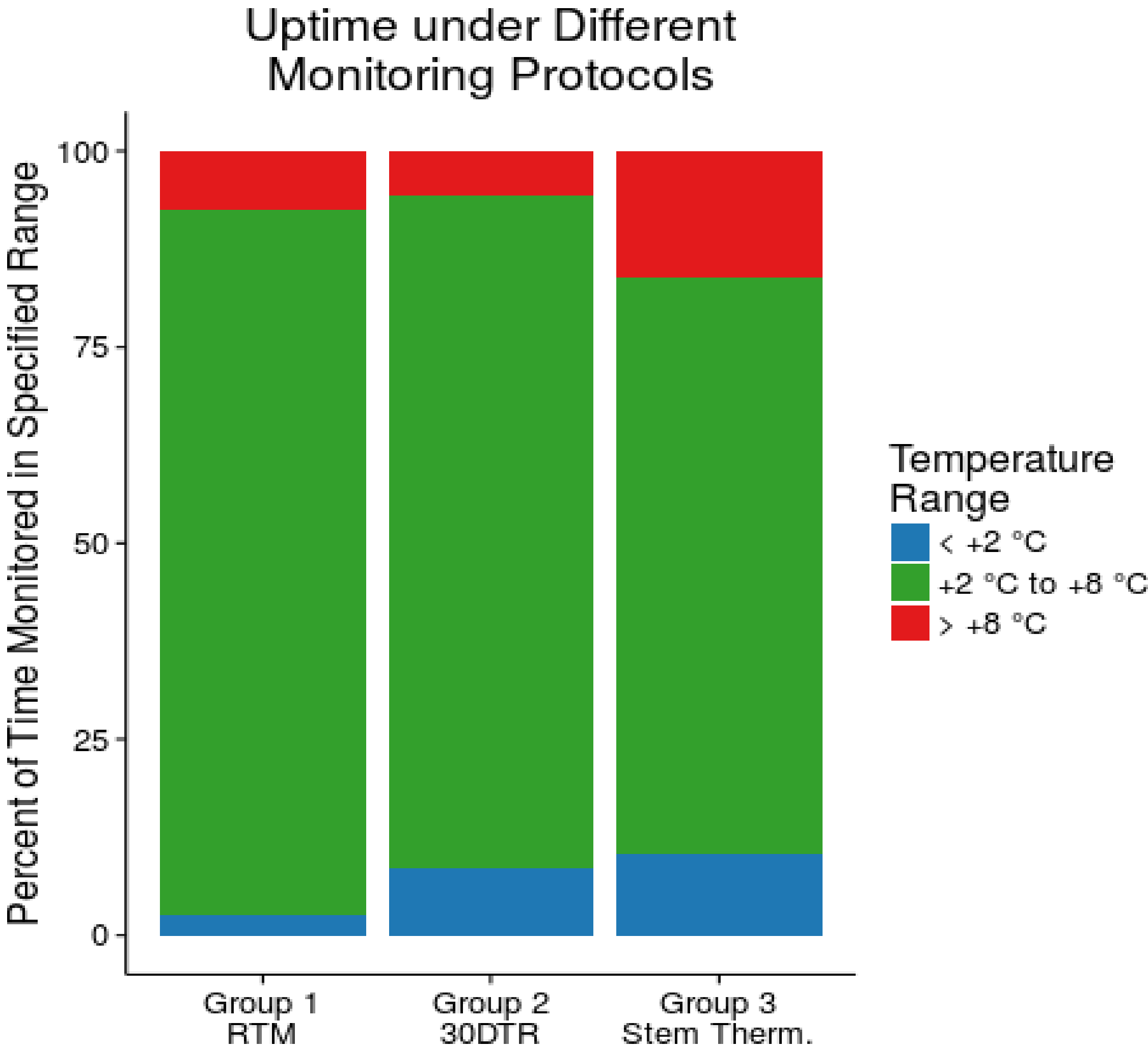
Critical Use-Case: SMS Alerts for Nurses



SMS ALERT: Temp is -2°C !
Vaccines kept too **COLD** for
7 hours, in danger of freezing.

**Refrigerator
Calls for Help**

Randomized Control Trial: Reduced Freezing and Improved Uptime with SMS Alerts



ColdTrace alerts
reduced total freezing
time by **74%**



Remote Diagnosis: Temperature Data Signatures

Clear patterns in temperature data viewable on the RTM dashboard can be used to **remotely diagnose** these types of fridge failures:

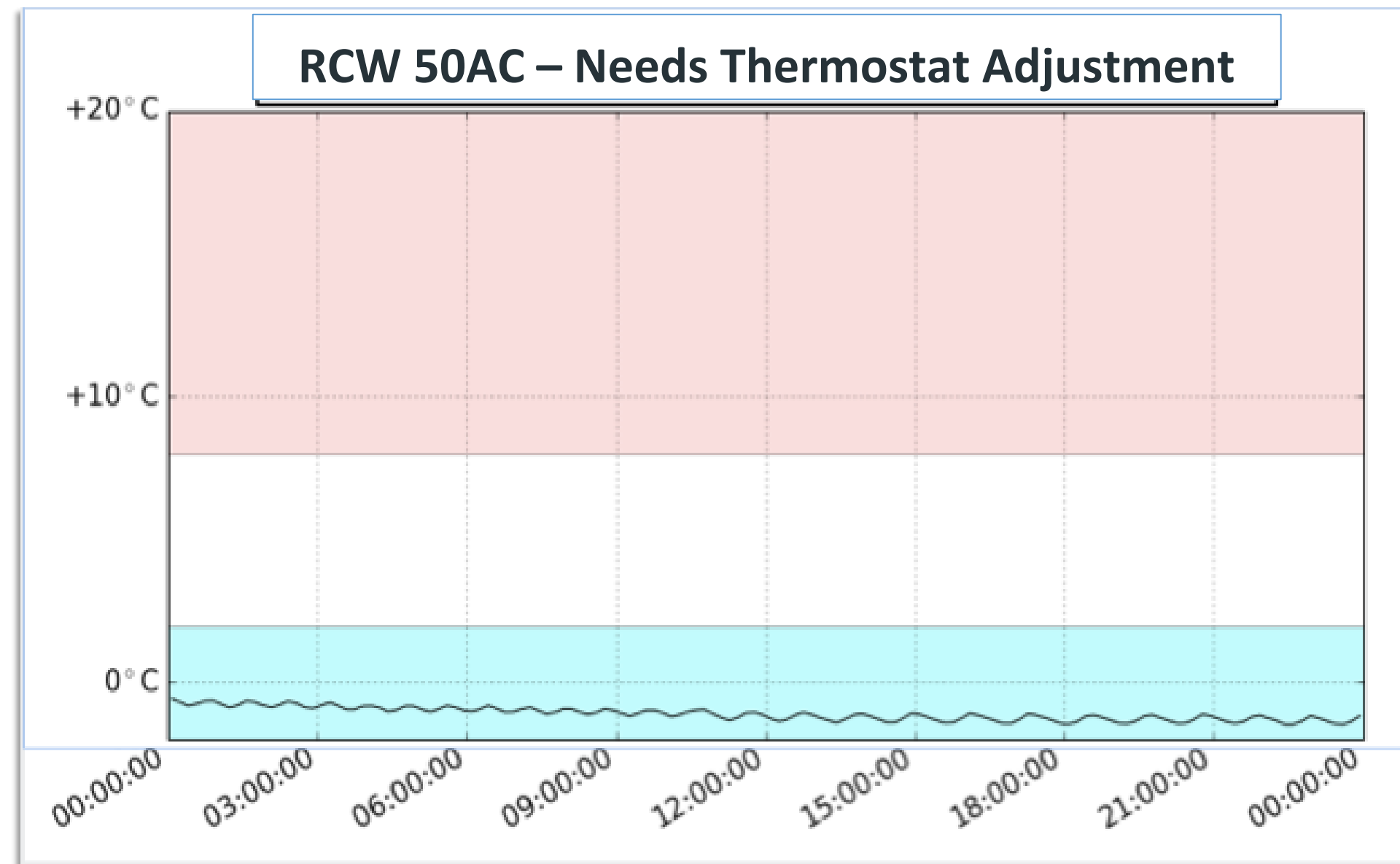


Figure E: Screenshot of ColdTrace dashboard showing 24 hours of temperature data from a fridge that **needs thermostat adjustment**. The temperature is consistently out of range.

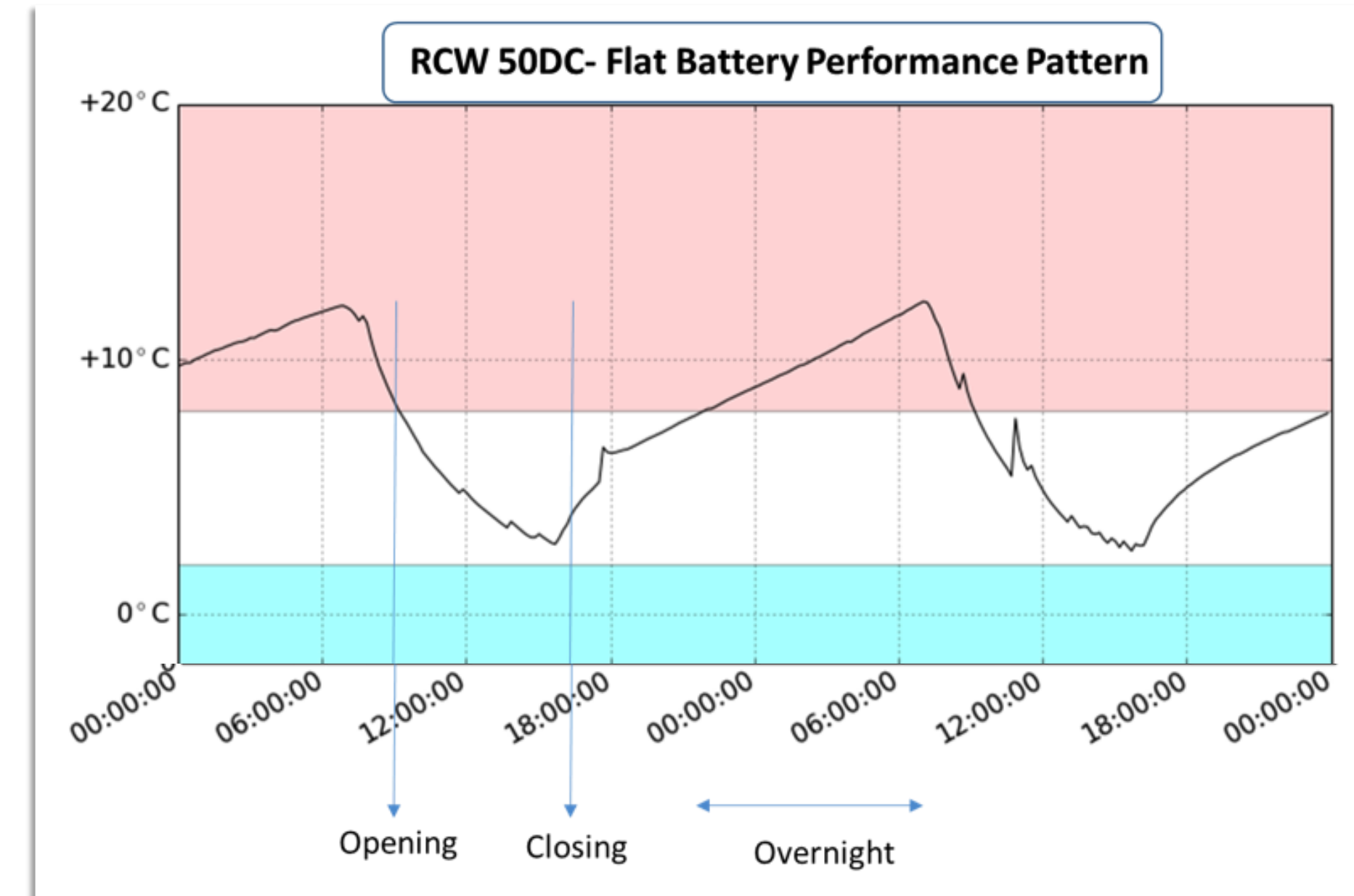


Figure F: Screenshot of ColdTrace dashboard showing 48 hours of temperature data from a **solar fridge with flat battery**. At opening and closing time, when facility personnel check the temperature of the fridge, the temperature appears between 2-8° C. However, temperature excursions occur overnight.

Fridges needing thermostat adjustments can be diagnosed & fixed remotely

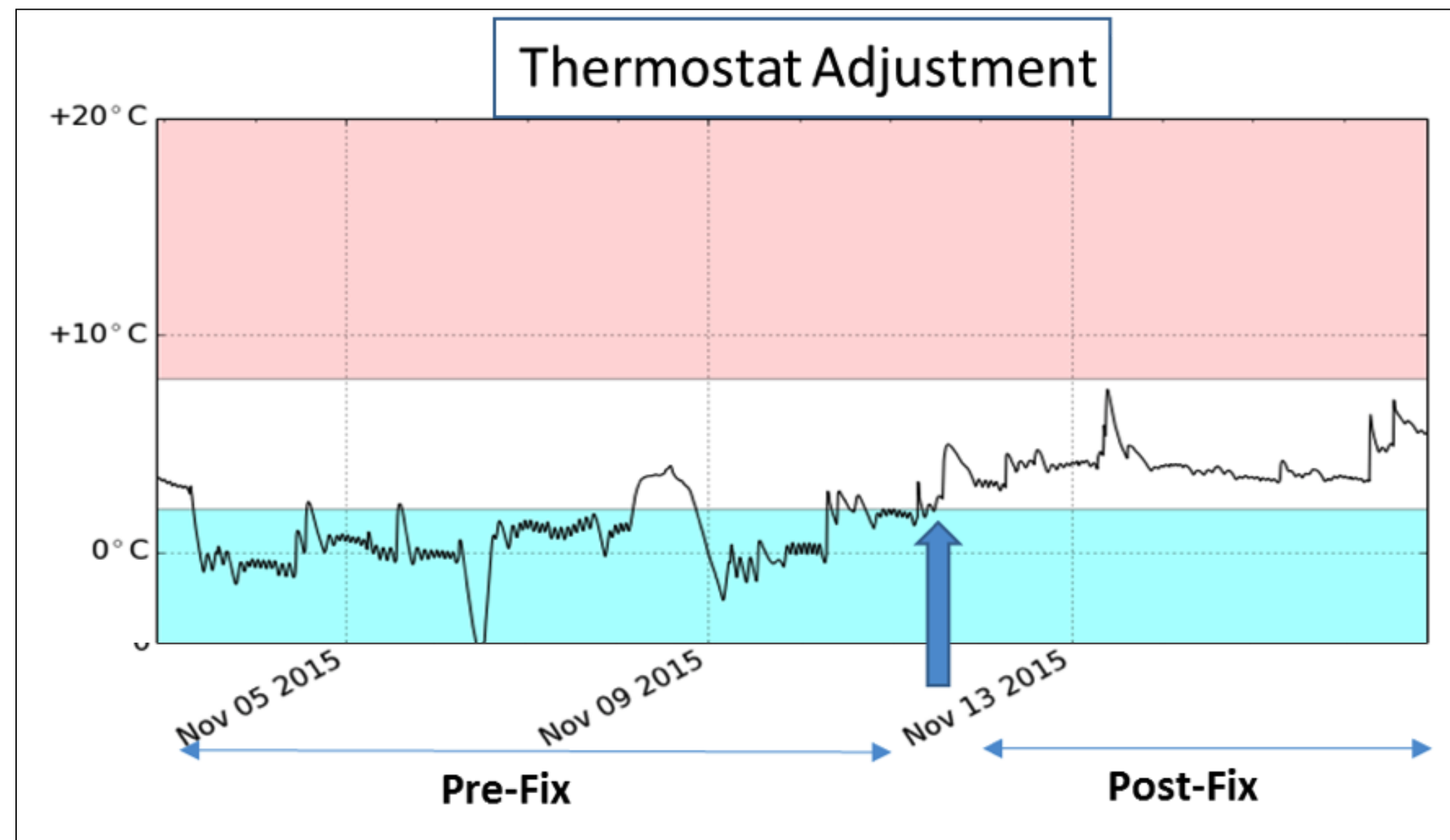


Figure A: Screenshot of ColdTrace dashboard showing temperature data from a fridge experiencing cold and freezing excursions before the thermostat adjustment, then performing in range after the adjustment.

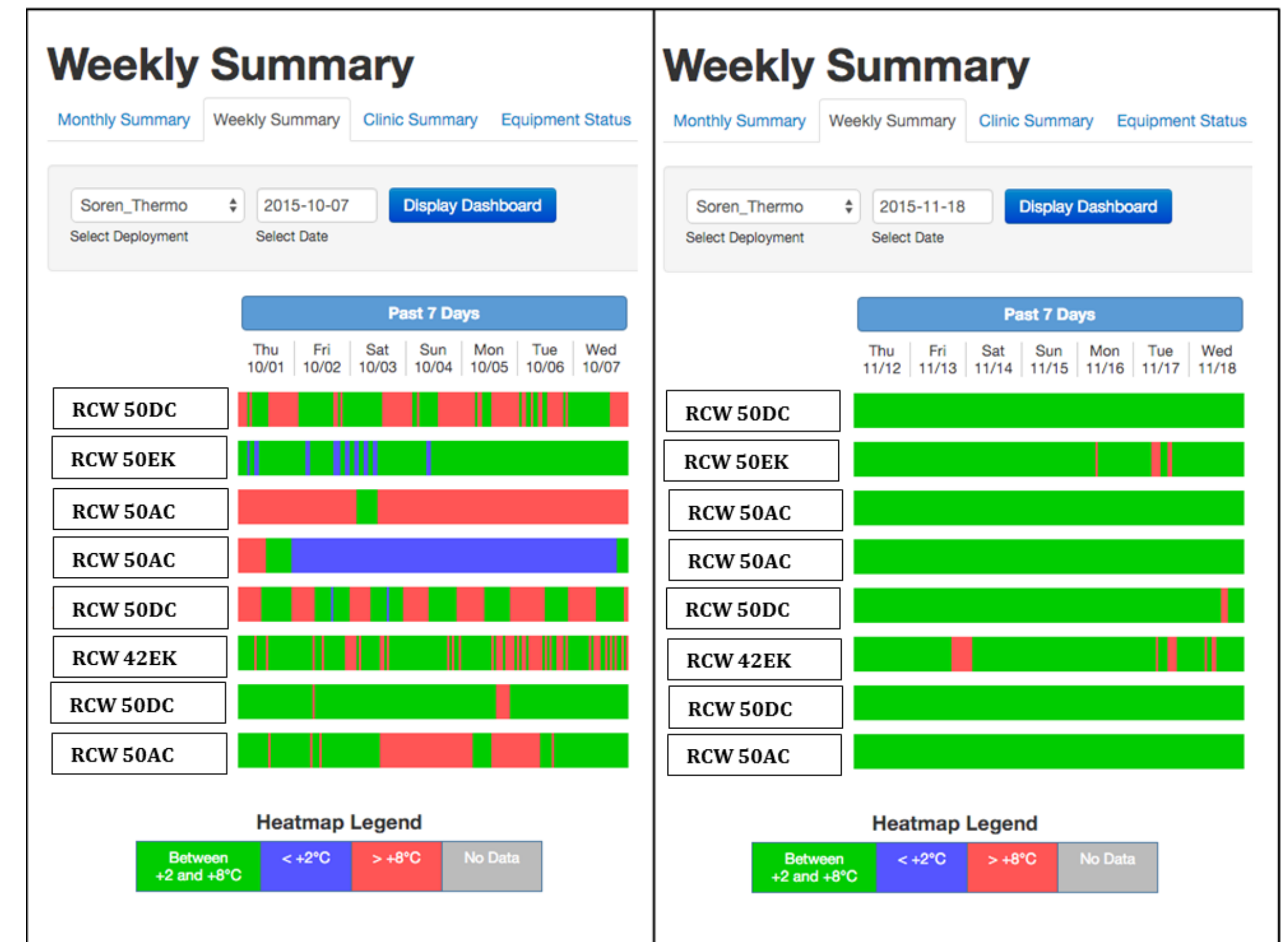
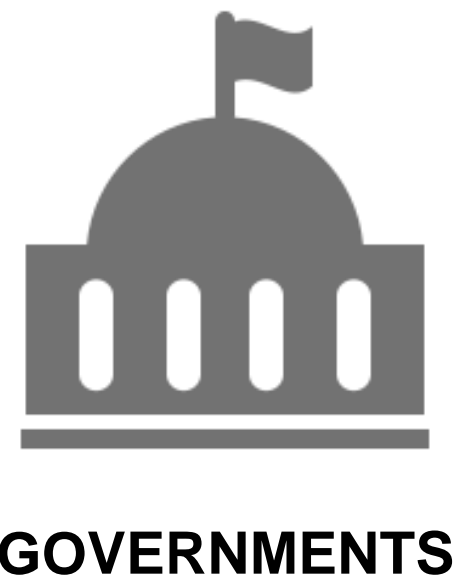


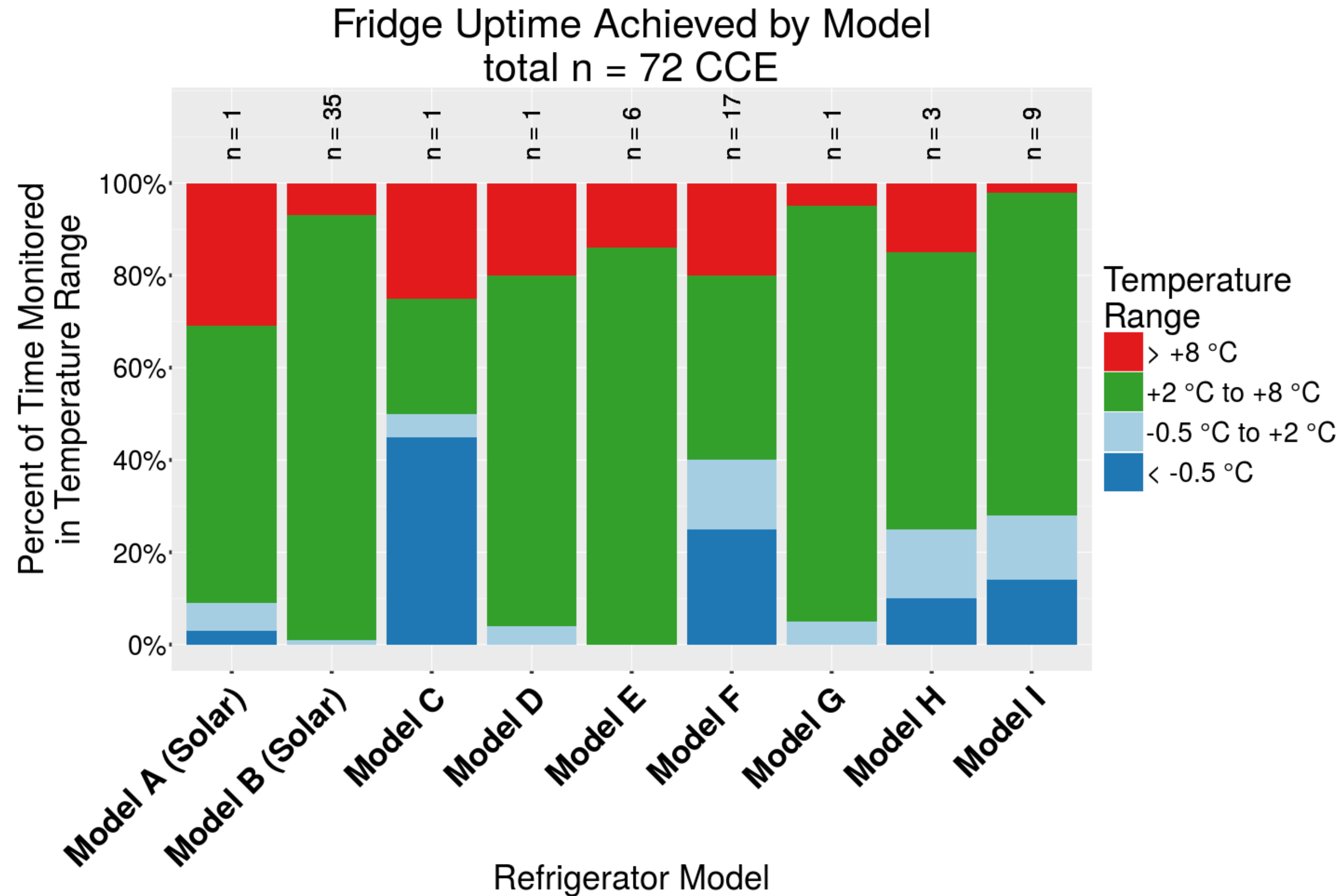
Figure B: Screenshot of ColdTrace dashboard weekly summary showing performance of 8 fridges before and after thermostat adjustment.

Turning Data into Actionable Information: **What Countries** **Need**



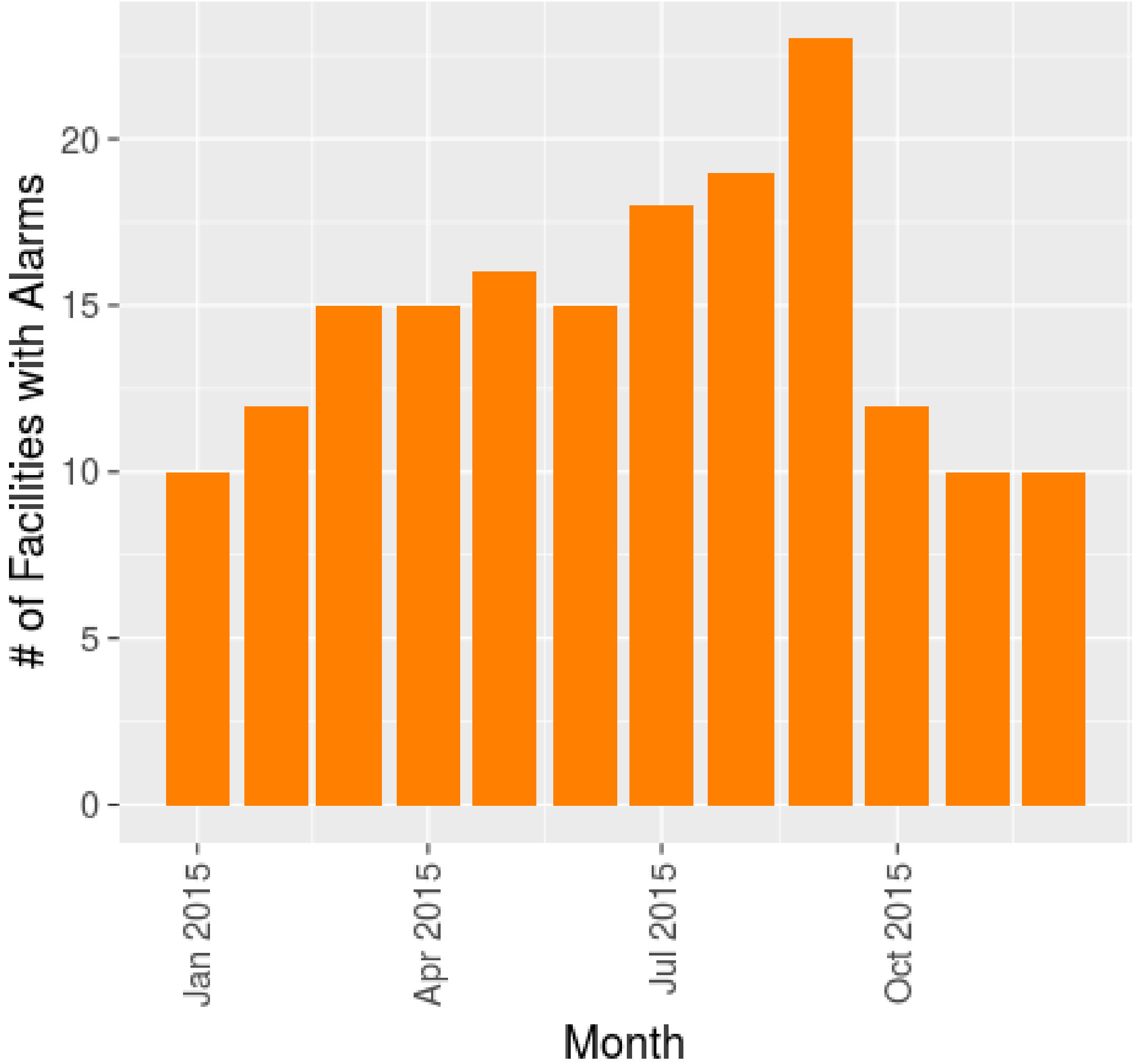
- Which of our fridges are failing the most? Which clinics need new fridges urgently?
- Which clinics in our country have unreliable power and need solar fridges?
- How much should we budget for spare parts and maintenance from year to year?
- Which fridges should we buy, based on actual performance in tough field conditions?
- How can we save money and protect expensive vaccines?
- How can we expand our vaccine system to reach even more children?

Supporting Ministries of Health: Data-Driven Budgeting & Procurement



Supporting Ministries of Health: Data-Driven Budgeting & Procurement

Region A : Facilities with Alarms



The Larger Impact: Data Visibility System-wide

1



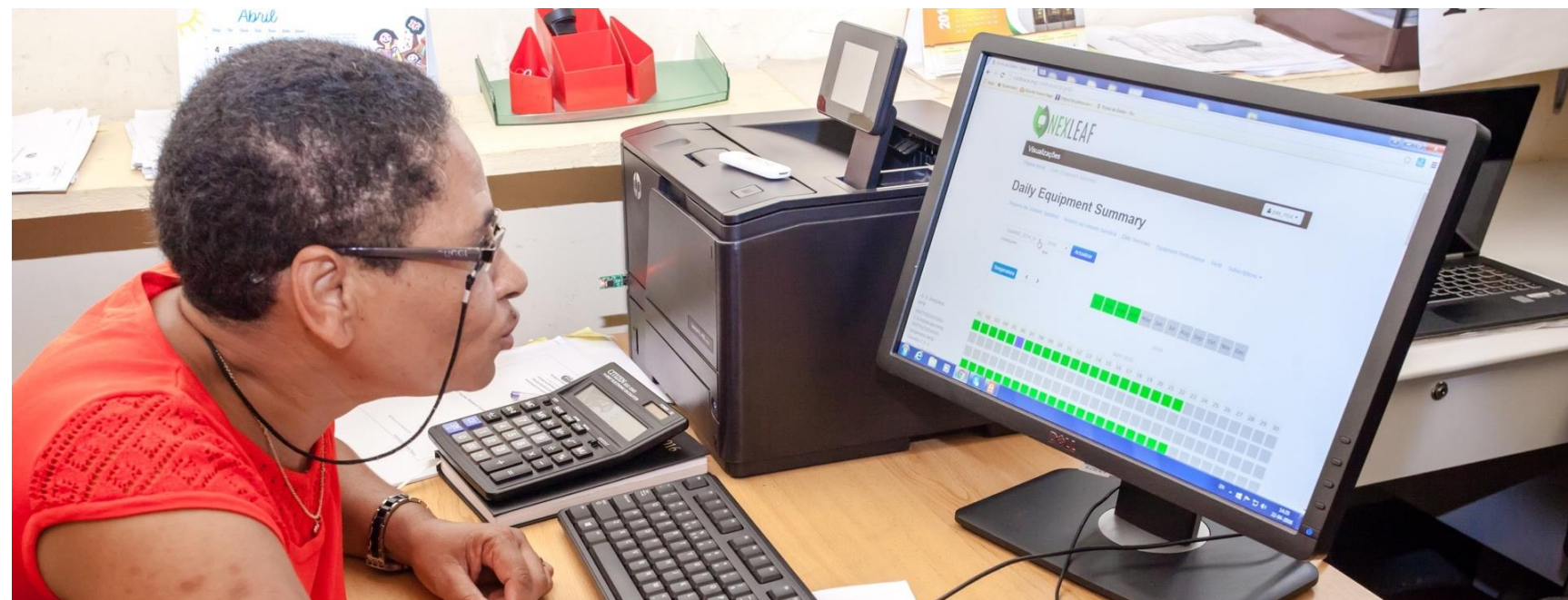
The nurse receives a text alert: **VACCINES IN DANGER**. She moves the vaccines.

2



The technician can tell what's wrong with a broken fridge remotely. He brings the right tools with him to the clinic and makes efficient repairs.

3



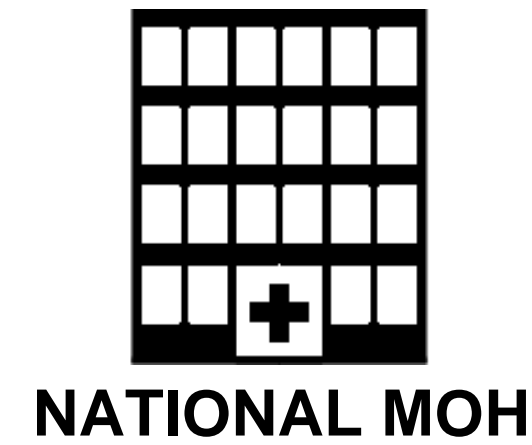
The health systems manager has a data-informed budget. She can afford spare parts and new fridges when they're needed. She keeps sending vaccines to the clinic.

4



Vaccines are protected. A baby gets a potent, life-saving vaccine.

Strengthening Cold Chain Management



- National Procurement and Maintenance Strategy



- Maintenance Planning and Information Flow



- Remote Fridge Repairs and Informed Facility Visits



- Temperature Alarms and Preventive Care

Lessons Learned / Best Practices

Data alone does not lead to impact



So how do we implement this technology to ensure data is used by nurses and managers to improve **vaccine cold chain?**

Technology Uptake: Training Nurses

Training nurses and creating SOPs to improve responses to alerts



A ColdTrace device continuously sends real-time data from the clinic.



When The Temperature in Your Fridge is TOO COLD: Below 2° C



When you receive an ALERT from ColdTrace that the temperature in your fridge is too cold, go through the following checklist

If you act immediately, you can help keep vaccines safe!

1. Make sure ColdTrace probe is not touching the ice, the metal wall or the bottom of the fridge. The probe should be secured on the wall with the clips.

2. Defrost the fridge if necessary.

- Check your defrost log: if you have not defrosted the fridge this month, please defrost
- If the ice thickness is more than 5 mm, then you need to defrost your fridge. Follow the guides on the PPM SOP for steps on how to defrost the fridge properly.

3. Do the shake test on one vial for every type of vaccine in the fridge. If the shake test fails for any vaccine:

- Perform the shake test on more vaccines and if they fail the test then remove all vaccines of that type.
- Record the failure in a vaccine wastage log. This step is important for showing the malfunction of your fridge.
- Set all failed vaccines aside for returning to the SDSMAS. You call -----for guidelines on how to proceed.

4. If Alert is not cleared (and you continue to get additional SMS alerts), then: Move thermostat down 1 or 2 steps.

- For example if the knob is at 4, you will place it on 2.
- If the knob is at the lowest setting, then your fridge has a problem and you need to report this issue.
- After adjusting the knob, monitor the temperature inside of the fridge until it is between 2-8 ° C .
- Make sure the door is securely closed.
- If you tried all these steps and it did not solve the problem then follow the next step for moving vaccines.

5. If the vaccines are OK, and if the fridge problem continues, move the vaccines to a safe place.

Choose one of the following options:

Option #1)

- Move the vaccine to back-up storage unit, if available OR store the vaccines in a pre-cooler insulated container with cold packs and a thermometer. Continue to monitor the temperature inside the container until the normal vaccine refrigerator is ready for use again.

Option #2)

- Call _____ to coordinate moving the vaccines to a clinic in close proximity with a working fridge.

- For transferring the vaccines, have a cold box with enough cold packs to keep the temp between 2-8 ° C

Check the temperature of the box with a thermometer before placing and transferring the vaccines.

_____, Phone Number: _____

Sense of Ownership: Ministry of Health should be involved in the training, installation and implementation of the technology



Technology Uptake: Training Technicians & Managers

- Training technicians and supervisors to access and use the data
- Link the use-cases of data to every day tasks and decision making
- Do not overwhelm users with unnecessary data - only provide data that **answers their questions**
- Conduct refresher trainings - video trainings in cases of staff transition



Challenges in the Field

- Connectivity
- Staff transition
- Monthly recharge of the SIMs
- Ministry independently sustaining the long-term cost of RTM
- Demonstrating the return of investment

When Designing Innovative Technology Solutions...

- Technology has to be made around the needs of the users/target population.
- Has to be tested many times in the field!
- Co-design and iterate on the reports and visualizations with users' feedback.
- Interoperability: Integrating with existing data management systems in the country.
- Allow **customization** - language translation
- Learn best practices from other partners who have succeeded in implementation of similar projects
- When designing it think about **sustainability** and **replicability** of the project by countries (without your help!)
- **Never stop monitoring and measuring impact of the technology (it can always be better!)**

Thank You



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