8

Managing a power failure

Power failures occur for many reasons. How a power failure is managed in your organisation may depend on the cause of the power outage, whether prior notice was given and the time of day the outage occurs. The safety and wellbeing of staff should always be considered when managing power failures, particularly when they occur outside business hours.

Some power networks send letters or provide text message alerts for power outages. Check with your local power networks whether this service is available in your state or territory.

A printable checklist for managing a power failure is provided in Appendix 9.

8.1 Back-up plans

Always have a back-up plan and alternative storage if a power failure occurs.

This will allow vaccines to continue to be stored between the recommended temperatures of +2°C and +8°C, thereby minimising vaccine loss and disruption to your facility's activities.

Alternative vaccine storage in the event of a power failure may include any of the following:

- a back-up power supply (eg generator or battery/solar back-up)
- a monitored refrigerator offsite (eg at a local hospital or pharmacy) — ensure that an agreement has been put in place with the relevant organisation before the event, and also consider that this organisation may be affected by the same power failure
- a cooler — each facility should ensure that they have enough coolers for an emergency.

If using a cooler, ensure that it will be large enough to accommodate:

- all vaccines, loosely packed
- ice packs or gel packs

- insulating material (eg polystyrene chips or bubble-wrap)
- a minimum/maximum thermometer or data logger.

Each immunisation facility should practise implementing its back-up plan, including practising packing vaccines into alternative storage, to ensure that the plan will work in a real power failure situation. Keep in mind that there may be only a short window of time before the vaccine refrigerator temperature rises above +8°C — suitable alternative storage must be ready quickly. Ensure that the back-up plan is clearly documented in the vaccine management protocol. The information provided here is a general guide only and may not be applicable to each facility — careful planning and practice will ensure that your back-up plan will work for your facility.

8.2 Purpose-built vaccine refrigerators

Depending on the quality and design of your purpose-built vaccine refrigerator, and the ambient temperature of the facility, the refrigerator may warm quickly during a power failure. Contact the refrigerator manufacturer to establish this time period and document it as part of your power outage plan.

Note: Not all purpose-built vaccine refrigerators continue to display the current temperature during a power failure. To overcome this issue, use a separate battery-operated minimum/maximum thermometer or data logger to continuously monitor refrigerator temperatures during power outages.

If the temperature of the refrigerator is about to exceed +8°C for longer than 15 minutes and vaccines are at risk, use alternative monitored storage arrangements.

8.3 When power goes off

During business hours

1. Immediately isolate the vaccines and keep them refrigerated between +2°C and +8°C. Leave the vaccines in the refrigerator with the door closed. Put a sign on the refrigerator door stating: 'Power out. Do not use vaccines. Keep refrigerator door closed.'
2. Closely monitor the refrigerator temperature using a battery-operated minimum/maximum thermometer or portable data logger. Ideally, this should be done using a standalone minimum/maximum thermometer with an external display to limit the need to open the door.
3. If the temperature rises to +8°C, move vaccines to a prepared cooler, cold box or portable purpose-built vaccine refrigerator. Ensure that all vaccines are packed and monitored with a digital minimum/maximum thermometer or data logger. See Section 9.3 'How to pack a cooler'.
4. Ensure that you have a strategy in place for long-term storage. Your state or territory health department may be able to assist you.

Never transport vaccines to another vaccine refrigerator, cooler or cold box without a minimum/maximum thermometer or data logger to monitor the temperature. Domestic refrigerators (including bar fridges) are not built or designed to store vaccines and must not be used for vaccine storage. Refer to your state or territory health department for further advice. If there is no suitable alternative monitored storage option, isolate the vaccines and leave them in the refrigerator with the door closed for the duration of the power outage.

Outside business hours

If there is a power failure outside normal business hours, such as during a storm, the safety, health and wellbeing of staff should be the main priority. Depending on the temperature-monitoring and alarm systems in use, an alert may be sent to the registered user by text message or email (see Section 4.6 'Automated temperature-monitoring systems'). The alerted staff member can take action, if safe to do so, to prevent vaccine losses.

8.4 When power is returned

- Record the minimum and maximum refrigerator temperatures.
- Reset the refrigerator temperature when the temperature reaches +8°C or less.
- Ensure that the refrigerator temperature has returned to between +2°C and +8°C before returning vaccines.
- If a cold chain breach has occurred, isolate vaccines until you seek advice from your state or territory health department. The health department will require vaccine details, data logging and twice-daily readings to assess the breach. See contact details on the last page of these guidelines.

  Do not use or discard vaccines until you have received advice from your state or territory health department.
- Monitor the refrigerator closely (eg hourly) to ensure that the temperature is consistently stable, then return to twice-daily monitoring.

If necessary, follow the cold chain breach protocol described in Appendix 3. This appendix details important information to have on hand when reporting a cold chain breach to your state or territory health department.

9

Coolers

A cooler, or esky, is a solid-walled insulated container with a tightly fitting lid, or a vaccine-specific soft-walled cooler. The temperature inside can be maintained using ice packs or gel packs. Coolers are usually portable.

High-quality coolers are available from large boating, fishing or camping suppliers. They have thick refrigerator-grade insulation, and fibreglass or plastic walls. Some may have small 'feet', which ensure that the cooler does not contact warm surfaces such as the floor of a car boot. Check with the manufacturer about the technical specifications and performance of the cooler.

Coolers have a limited 'cold life' and are therefore not adequate for vaccine storage for prolonged periods (more than 8 hours) or in extreme conditions. In these circumstances, a specialised cooler should be used for storing and transporting vaccines (see Section 9.4).

9.1 Tips for using coolers

Immunisation service providers should choose coolers that will meet their facility's needs.

- Freezing episodes can occur in all coolers, usually in the first 2 hours after packing. The minimum size cooler recommended for storing vaccines is 10 litres.
- Consider the quantity of vaccines stored in your vaccine refrigerator to determine the minimum number of coolers and equipment you will require if you need to transfer your vaccines to prevent a cold chain breach.
- Polystyrene coolers provide limited insulation and are only suitable for storing vaccines for short periods (up to 4 hours).
- If using a polystyrene cooler, change to a plastic cooler if the polystyrene cooler is not maintaining a stable temperature.

- If using a plastic cooler that is not maintaining a stable temperature, consider upgrading to a higher-quality cooler with refrigeration-type insulation, or a specialised cooler.

The number of ice packs or gel packs required (see Section 9.2) will depend on:

- ambient temperature
- type and size of cooler
- number of vaccines
- cooler capacity
- size and type of ice packs/gel packs.

When using coolers, always do the following:

- Condition the ice packs or gel packs (see Section 9.2).
- Correctly pack the cooler to reduce the risk of freezing (see Section 9.3).
  - Pre-chill the cooler before use.
  - Insulate the vaccines with appropriate material so they do not come into contact with ice packs/gel packs that are at 0°C. For example, loosely wrap vaccines in bubble-wrap, allowing cool air to circulate; avoid wrapping tightly.
- Monitor and record the temperature every 15 minutes for the first 2 hours, then at least hourly (provided that temperatures are stable) using a battery-operated minimum/maximum thermometer. The thermometer should be reset after each reading for accuracy.
- Ensure that the contents of the cooler are packed securely so they cannot move around during transport.
- Keep the cooler out of the direct sun.
- Remove vaccines from the cooler only as they are required.
- Check that the temperature has remained between +2°C and +8°C before administering the vaccine.

9.2 Freezing and conditioning ice packs and gel packs

Ice packs

Ice packs are water filled and can come out of the freezer at a temperature as low as −18°C, which is significantly lower than the freezing point of the ice pack. Achieving the lower temperature will provide a longer cold life for the ice pack.

How to condition ice packs

Condition ice packs as follows:

- Remove ice packs from the freezer.
- Lay out ice packs in a single row on their sides (where possible), leaving a 5cm space around each ice pack to allow maximum air exposure. This reduces the conditioning time.
- Wait until ice packs begin to sweat. This will take up to 1 hour at +20°C.
- The ice pack is conditioned as soon as water begins to 'slosh' about slightly inside the ice pack.

Gel packs

Some types of gel packs contain chemicals that depress the freezing point of the pack and ensure that the gel remains colder than 0°C for longer than water-filled ice packs. Before purchasing gel packs, request documentation from the manufacturer that:

- validates their claims about the product's cold life
- provides clear instructions on how to freeze and condition the product before use, and how to safely pack a cooler with the gel pack and vaccines.

How to condition gel packs

Usually gel packs will take longer to condition than ice packs.

Follow the manufacturer's instructions for conditioning the gel pack. Although there is no 'one rule fits all' approach, there are some industry standards that can be used to guide conditioning if gel packs have been stored in the freezer at −20°C for a minimum of 36 hours.

Conditioning frozen gel packs for the times prescribed below enables the initial chill factor to be removed from the packs.

Guide to time needed to condition small and large gel packs

Gel packs weighing less than 750g

- If ambient (room) temperature is **over** +15°C, condition for 45 minutes before use.
- If ambient temperature is **under** +15°C, condition for 1 hour before use.

Gel packs weighing more than 750g

- If ambient (room) temperature is **over** +15°C, condition for 1 hour before use.
- If ambient temperature is **under** +15°C, condition for 1½ hours before use.

9.3 How to pack a cooler

One of the greatest risks to vaccines is freezing during transport in a cooler. The risk of freezing increases if the ice packs/gel packs are not correctly conditioned.

Freezing episodes occur easily in all coolers, usually in the first 2 hours after packing. Monitor the temperature every 15 minutes for the first 2 hours, and then at least hourly.

OPTION ONE: Packing vaccines directly into a cooler

This option can be used for storing vaccines in a cooler for up to 8 hours.

1. Chill the inside of the cooler before use by placing ice packs/gel packs in it for a few hours (Figure 2), and then remove the ice packs/gel packs.
2. Place polystyrene chips or other suitable insulating material at the bottom of the container (Figure 3). This eliminates 'hot' and 'cold' spots. Packaging such as polystyrene chips is preferable to bubble-wrap because it promotes air circulation. If using bubble-wrap, avoid wrapping the vaccines tightly.
3. Place vaccine stock on top of the insulating material (Figure 4).
4. Place a minimum/maximum thermometer (or a dual time–temperature indicator if they are used in your state or territory) or data logger in the centre of the vaccine stock (Figure 5).
5. Place the thermometer probe in an empty vaccine box (with the product information intact) to protect it from lying directly on ice.
6. Surround the vaccines with packing material that allows cold air to circulate.
7. Place the conditioned ice packs/gel packs on top of the insulating material (Figure 6), and close and seal the lid of the cooler. If using a larger cooler, place conditioned ice packs/gel packs around the sides of the cooler as well as on top. Experiment to find the best combination.
8. Ensure that vaccine stock is not in direct contact with the ice packs/gel packs, to minimise the risk of freezing.
9. Place the display screen of the minimum/maximum thermometer on the outside of the cooler for easy monitoring and recording of vaccine temperatures (Figure 7).
10. Commence monitoring before leaving for the session. Monitor the temperature every 15 minutes for the first 2 hours, and then at least hourly throughout the immunisation session, and before administering vaccines (see Appendix 8 'Checklist and temperature chart for mobile or outreach immunisation clinics, or emergency storage of vaccines').

Figure 2: Ice packs/gel packs placed in bottom of cooler to chill cooler

Figure 3: Insulating material placed in bottom of cooler

Figure 4: Vaccines packed in cooler

Figure 5: Minimum/maximum thermometer placed in centre of vaccine stock

Note: A data logger (if available) can also be placed with the minimum/maximum probe.

Figure 6: Insulating material placed on top of vaccine stock followed by ice packs/gel packs

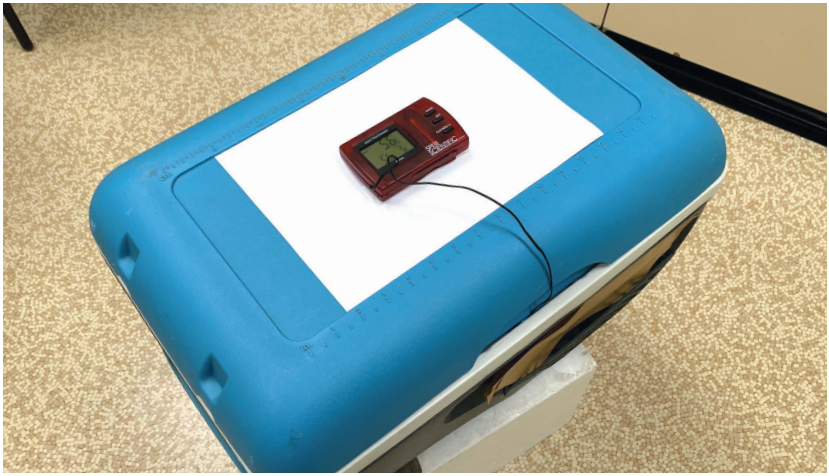

Figure 7: Minimum/maximum thermometer display placed outside cooler

OPTION TWO: Packing vaccines into a polystyrene container that is then placed into a larger cooler

1. Choose a suitably sized polystyrene container and chill the inside by placing ice packs/gel packs inside for a few hours.
2. Remove the ice packs/gel packs used to chill the inside and replace with conditioned ice packs/gel packs.
3. Place the vaccines and a minimum/maximum thermometer inside the polystyrene container, and secure the lid.
4. Ensure that the minimum/maximum thermometer probe is placed in the centre of the vaccine stock inside an empty vaccine box with the product information intact. The display screen should be placed on the outside of the cooler to allow recording of the temperature.
5. Pack the polystyrene container inside a large cooler and surround it with ice packs/gel packs. Secure the lid.
6. Monitor the temperature before leaving for the session, upon arrival, before administering vaccines and at least hourly throughout the immunisation session (see Appendix 8 ‘Checklist and temperature chart for mobile or outreach immunisation clinics, or emergency storage of vaccines’).

Note: Test temperature stability before placing vaccines in the polystyrene container.

9.4 Specialised vaccine coolers

A vaccine cooler is a purpose-built product. It has thick walls and is significantly more expensive than a standard cooler.

The cooler insulation should be at least 30mm thick and, if possible, 80mm thick in the walls and lid. Fibreglass coolers with 50mm refrigeration-grade insulation are available.

For long-term storage (more than 8 hours) or storage in extreme conditions (where the temperature of the storage environment is <0°C or >40°C), a specialised cooler is needed. Specialised coolers are available that meet World Health Organization (WHO) recommendations.

A large cooler should have a minimum cold life of 120 hours when exposed to temperatures up to +43°C without being opened.

WHO specifications are available at: www.who.int/immunization_standards/vaccine_quality/pqs_e04_insulated_containers/en.

Temperature chart for mobile or outreach immunisation clinics, or emergency storage of vaccines

Date	Monitoring times P = vaccines packed A = arrived at clinic D = during clinic B = arrived at base	Time	Minimum temperature	Maximum temperature	Temperatures outside +2°C to +8°C Yes/No If yes, must be notified*	Signature

*State or territory health department contact number	

APPENDIX 9:

Checklist for managing a power failure

Checklist for emergency storage (eg power or refrigerator failure)

Your vaccine refrigerator may warm quickly during a power failure, depending on the quality and design of the refrigerator, and the ambient temperature of your facility. You may need to contact the refrigerator manufacturer to establish this time period.

If vaccines are at risk, use alternative monitored storage arrangements.

Step	What to do	Done ☑☒
1	Immediately isolate the vaccines and keep them refrigerated between +2°C and +8°C. Leave the vaccines in the refrigerator with the door closed. Put a sign on the refrigerator door stating: 'Power out. Do not use vaccines. Keep refrigerator door closed.'	☐
2	Closely monitor the refrigerator temperature. Ensure that the display of the minimum/maximum thermometer is outside the refrigerator so that readings can be obtained without opening the refrigerator door.	☐
3	Immediately begin to condition ice packs/gel packs as per Section 9.2 of *Strive for 5*. Begin this process even if you have been informed that the power will return shortly.	☐

Step	What to do	Done ☑☒
4	Place additional ice packs/gel packs in a cooler to pre-chill the cooler.	☐
5	Transfer vaccines to the cooler when the minimum/maximum thermometer shows that the temperature of the refrigerator is outside the recommended +2°C to +8°C range. If unable to read the thermometer, transfer vaccines as soon as ice packs/ gel packs are conditioned. Pack the cooler as per Section 9.3 of *Strive for 5*. If a minimum/maximum thermometer is available, place the probe in the cooler and the display outside the cooler.	☐
6	Monitor and record the cooler temperature every 15 minutes for the first 2 hours, then at least hourly (provided the temperatures are stable).	☐
7	Ensure that a data logger is placed directly next to vaccines in the cooler.	☐
8	Do not open the cooler until vaccines can be transferred to a purpose-built vaccine refrigerator.	☐
9	If more suitable vaccine storage is available (eg at a hospital with an essential power generator), transfer vaccines in a cooler to the more suitable option. Ensure that the data logger stays with the vaccines at all times.	☐
10	If you know that power will be out for more than 24 hours, consider transferring vaccines to alternative vaccine storage, if available, at the nearest facility with power.	☐

Support systems that may assist you to manage a power failure

- Some power networks provide timely power outage alerts to registered customers by text message or email.
- An automated monitoring system can be installed in purpose-built vaccine refrigerators. This system sends an electronic alert to designated phone number(s) outside business hours if the refrigerator temperature deviates outside the +2°C to +8°C range. The alerted staff member can take action outside business hours if it is safe to do so and may be able to prevent vaccine losses. They can also prevent the administration of potentially compromised vaccines to clients by alerting staff to a potential cold chain breach the next business day.
- A separate battery-operated minimum/maximum thermometer can assist in continuously monitoring refrigerator temperatures. During a power failure, not all purpose-built vaccine refrigerators continue to display the current temperature.

Alternative vaccine storage

In the event of a power failure, an alternative means of monitored vaccine storage is recommended to allow vaccines to continue to be stored between the recommended temperature range of +2°C to +8°C, thereby minimising vaccine loss and disruption to businesses. The recommended options may include any of the following:

- A back-up power supply (eg generator or battery/solar back-up)
- A monitored refrigerator offsite (eg local hospital or pharmacy)
  - Ensure that an agreement has been put in place with the relevant organisation before the event. Also consider that this organisation may be affected by the same power failure.
- A cooler
  - Ensure that the cooler is large enough to accommodate:
    > all vaccines

> ice packs or gel packs
> insulating material (eg polystyrene chips or bubble-wrap)
> a minimum/maximum thermometer or data logger
> a cold chain monitor.

– Pack the cooler as per Section 9.3 of *Strive for 5*.
– Monitor and record the temperature every 15 minutes for the first 2 hours, then at least hourly (provided the temperatures are stable).

When the power is returned

Step	What to do	Done ☑☒
1	Record the refrigerator temperature and reset the minimum/maximum thermometer.	☐
2	Ensure that the refrigerator temperature has returned to between +2°C and +8°C before returning vaccines.	☐
3	Transfer vaccines to the refrigerator.	☐
4	If a data logger has been transported with vaccines, download the data before using any vaccines.	☐
5	If the data show temperatures outside the +2°C to +8°C range, isolate vaccines, clearly mark them 'Do not use', and keep them refrigerated between +2°C and +8°C. If a cold chain breach has occurred, report it to your state or territory health department. Include all the information outlined in Appendix 3 'Cold chain breach protocol' of *Strive for 5*.	☐
6	Continue to monitor the refrigerator closely (eg hourly) to ensure that the temperature is consistently stable, then return to twice-daily monitoring.	☐