



Immunisation Advisory Centre (IMAC)
University of Auckland

IMMUNISATION ADVISORY CENTRE (IMAC)

VACCINE STORAGE

AND

DISTRIBUTION

NATIONAL STANDARDS

**Immunisation Advisory Centre
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FOREWARD

The success of an immunisation programme is dependent on the maintenance of vaccine potency by maintaining recommended temperature during storage and distribution.

The standards are based on guidelines from the World Health Organization's Expanded Programme on Immunisation (EPI) and cold chain research and experience in New Zealand.

The standards are intended to equip immunisation providers with the appropriate knowledge to maintain the vaccine cold chain, thereby increasing the proportion of effective vaccines that are administered and reducing vaccine wastage.

All persons handling vaccines are responsible for maintaining standards that will ensure vaccine potency at each step of the cold chain, and should therefore correct any problems as they arise.

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INTRODUCTION

The cold chain is the system of transporting and storing vaccines within the safe temperature range of +2 degrees to +8 degrees Celsius (°C). Vaccines are delicate biological substances that can become less effective or destroyed if they are:

- Allowed to become too cold
- Allowed to become too warm
- Exposed to sunlight or fluorescent light

Vaccines should be stored:

- As per WHO/EPI (World Health Organization/Expanded Programme on Immunisation) recommendations, and
- In accordance with good warehousing practice and the New Zealand code of good manufacturing practice for manufacture and distribution of therapeutic goods, and
- As per the recommendations in the *Immunisation Handbook, 2002*

The loss of vaccine effectiveness is cumulative and cannot be reversed.

1. The following free national immunisation schedule vaccines are cold sensitive and must not be stored below 2°C:

- Vaccines containing diphtheria, tetanus and or acellular pertussis
- *Haemophilus influenzae* type B vaccines
- Hepatitis B vaccines
- Injectable poliomyelitis – IPV Salk
- All combinations of the above
- Influenza
- Vaccine diluents

2. The following free national immunisation schedule vaccines are heat and light sensitive and must not be stored above 8°C or exposed to light:

- Bacille Calmette-Guerin (BCG)
- Measles-mumps-rubella (MMR) lyophilised powder
- Reconstituted measles-mumps-rubella (MMR)

Purchased vaccines such as Hepatitis A, Hepatitis B, Pneumococcal, Meningococcal and travel vaccines are also required to be stored between +2 to +8 °C. Note, while Tuberculin (PDP) for mantoux testing is not a vaccine, it should not be stored below 0°C.

3. The two essential elements of the cold chain system that ensure vaccine recipients receive potent vaccines are:

- i) People managing vaccine storage and distribution, and
- ii) Equipment for storing, transporting and monitoring vaccines (Refer to Appendix 1)
 - A designated 'for vaccines only' refrigerator (Refer to Appendix 2)
 - A means of recording and documenting the minimum / maximum temperature on a daily basis (for example, analogue or digital minimum maximum thermometer and recording sheet, electronic data logger, temperature monitoring computer software)
 - Insulated container (Refer to A.6.1 and Appendix 3) and associated materials (eg. icepacks, shredded paper and polystyrene sheet for separating vaccines from the icepacks) for transporting or storing vaccines

The *Immunisation Handbook 2002* has a comprehensive section on vaccine storage, P56 to 64.

Ordering Vaccine:

- Vaccine stock should be kept to a minimum through regular ordering and by ordering only the quantity of vaccine required for the period until the next scheduled delivery. Each immunisation provider (practice) is entitled to two free deliveries per month.
- Immunisation providers should use the following formula to determine their vaccine requirements:

The number of patients to be recalled for the month per immunisation event, plus an extra 5 - 10 doses of each vaccine for a buffer, divided by two (two deliveries per month).

It should be noted that the minimum ordering quantity of some vaccines is a box of 10 doses and this will need to be taken into consideration when ordering.

For example:

Event	No of Patients Due	Vaccines	
6 wk	15	DTaP-IPV	15
		Hib-HepB	15
3 mth	15	DTaP-IPV	15
		Hib-HepB	15
5 mth	15	DTaP-IPV	15
		Hep B	15
15 mth	20	DTaP/Hib	20
		MMR	20
4 yrs	25	DTaP-IPV	25
		MMR	25
11 yrs	25	Td	15
		IPV	5
45 yrs	25	Td	25
65 yrs	20	Td	20

Add up the number of vaccines required:

Vaccines	Doses Required for Month	Buffer	New Total	1st Order	2 nd Order
DTaP-IPV	65	5	70	40	30
Hib-HepB	65	5	70	40	30
Hep B	15	5	20	10	10
DTaP/Hib	20	5	30	20	10
MMR	45	5	50	30	20
Td	60	5	70	40	30
IPV	5	5	10	5	5

The second order can be adjusted if needed i.e. Increased or decreased.

Storing excess vaccine increases the risk of vaccine wastage due to:

- Vaccines being exposed to temperatures outside the recommended +2 to +8 °C
- Expiry

In the event of any sudden variations in refrigerator temperature or recordings outside the recommended +2 to +8 °C or equipment failure, contact the Local Immunisation Coordinator, Medical Officer of Health, Public Health Service or IMAC for advice and support before discarding any vaccines.

The video '*The Vaccine Cold Chair*' is available from your Local Immunisation Coordinator or the Immunisation Advisory Centre (IMAC).

STANDARDS FOR VACCINE STORAGE & DISTRIBUTION LOCALLY, REGIONALLY & NATIONALLY.

The distribution of the publicly funded vaccines throughout New Zealand is through a direct delivery system, whereby vaccines move from the National Vaccine Store (situated at the Institute of Environmental Science & Research Ltd, Porirua, Wellington) to the Regional Stores (Zuellig Pharma Whangarei, Auckland, Hamilton, Wellington, Christchurch & Dunedin) and ends with the local immunisation provider.

Zuellig Pharma is only responsible for the distribution of vaccines. Any technical questions relating to vaccine should be directed to your Local Immunisation Coordinator, Medical Officer of Health, IMAC or the vaccine manufacturer.

A: LOCALLY

A.1. LOCAL IMMUNISATION PROVIDERS' RESPONSIBILITIES

- A.1.1 The immunisation provider (vaccinator) is responsible for notifying the regional distributor of their order and delivery requirements.
- A.1.2 The immunisation provider's responsibilities commence on receipt of the vaccines from the regional distributor.
- A.1.3 Each workplace at which immunisations take place, should have a refrigerator designated for the storage of vaccines. (Refer to Appendices 1 & 2)
- A.1.4 The person(s) involved in the unpacking and storage of the vaccines should have knowledge / in-depth understanding of the cold chain system, by undertaking appropriate training eg. A Vaccinator Training Course.
- A.1.5 The immunisation provider will take all due care to minimise the wastage of vaccines.
- A.1.6 The immunisation provider is responsible for managing vaccine stock in such a way that both the volume of vaccine kept and the length of time in storage is kept to a minimum.
- A.1.7 The immunisation provider will take due care to keep transportation of vaccines, and storage outside a vaccine-designated refrigerator, to the minimum time possible.
- A.1.8 Emergency protocols should be in place and posted near the refrigerator in case of power/equipment failure.

A.2 RECEIPT OF VACCINES

- A.2.1 On receipt of vaccines, the immunisation provider is to check the cardboard box / chilly bin contents against the order form, then sign for the vaccines from the courier with the date and time.

If the provider has reason to believe the vaccines have not been kept at the required temperature eg. The vaccines are warm to touch or the time is over the 4-hour 'safe window' delivery period (or alternative time as determined by the Ministry of Health), the provider is to:

- Notify their Zuellig Pharma distributor
- Return the vaccines to Zuellig, marked Vaccines for Destruction, so the vaccines don't re-enter the system (provider to obtain a courier number from Zuellig Pharma)

The order will be replaced by Zuellig Pharma.

A.2.2 All vaccines must be unpacked and refrigerated immediately on delivery. It is recommended that vaccinators keep a log containing the date, name and batch numbers of vaccines arriving from the supplier.

A.2.3 The state of any cold chain monitor arriving with the vaccine should be noted and recorded on the Monitor Record Card. The monitors must remain with the vaccines they arrived with.

A.3 VACCINE REFRIGERATOR

A.3.1 All vaccines must be stored in a refrigerator that is capable of maintaining +2°C to +8°C (Refer to Appendix 1)

A.3.2 As per the Medicines Act 1984, each workplace must have a refrigerator designated for the storage of vaccines. Food should not be stored in the designated vaccine refrigerator. (Refer to Appendix 2)

A.3.3 If using a domestic type refrigerator, the refrigerator should be of sufficient size to accommodate vaccine storage requirements while only being 50% full i.e. not exceeding 50% of the fridge's storage capacity (Grassby, 1993) . (Refer to A.4.2, A.4.3 and Appendix 1)

A.3.4 The refrigerator must be in a reasonably sized well-ventilated room and not in direct sunlight or against a heat source, as the efficiency of refrigeration equipment declines with high ambient temperatures.

A.3.5 If during the winter period the room temperature regularly drops to low overnight temperatures, then the refrigerator should be placed alongside an internal rather than external wall.

A.3.6 The refrigerator should be placed at least 10 cm away from surrounding wall surfaces to allow air to circulate around the condenser.

A.3.7 The refrigerator door seals should be in a good condition so as to allow the door to close easily and securely.

A.3.8 The refrigerator must be positioned to ensure the door self-seals (closes) if the door is left ajar.

A.3.9 The refrigerator should be clean and maintained in good condition.

A.3.10 The refrigerator should have steel (grill type) shelving to allow for air circulation. Glass or plastic shelves prevent / reduce air circulation, which will increase the temperature gradient found within a domestic type refrigerator cabinet.

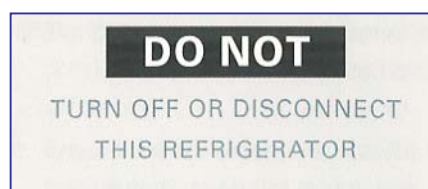
A.3.11 Non self-defrosting refrigerators should be defrosted once 5 mm of ice forms on the icebox. Ice forming unevenly over the icebox or iceplate may indicate impaired refrigerator function, in which case a refrigeration engineer should check the refrigerator as soon as possible.

A.3.12 Non self-defrosting refrigerators should have a drip tray under the icebox, and clear flowing drip tracks in self-defrosting refrigerators.

A.3.13 During defrosting vaccines should be removed to a second monitored refrigerator or stored in an insulated container, which is packed and monitored by a reliable and tested method e.g. cardboard box or chilly bin methods as per A.6.1 through to A.6.9.

A.3.14 The refrigerator is to be left on at all times and it is recommended a sign be placed near the power point, in a bright colour preferably red, indicating the refrigerator must not be disconnected or turned off under any circumstances.

eg



A.3.15 During a power failure of 4 hours or less, the refrigerator door should be left closed. If the power fails for more than 4 hours, vaccines should be transferred to an insulated container with the correct number and sizes of icepacks to ensure the vaccines will remain at +2°C to +8°C. (Refer to Appendix 3)

A.4. VACCINE STORAGE

A.4.1 Vaccines must be left in their packets or packaging, as this provides insulation and helps protect against thermal insult.

A.4.2 Amount of vaccine stored

- i) If using a domestic type refrigerator the amount of vaccine stored should only take up to 50% of the refrigerator's storage capacity and only the section(s) of the refrigerator being monitored, should be used (Grassby, 1993). This is because there are variable temperature zones within a domestic type refrigerator cabinet and the temperature gradient increases in proportion to the degree of packing.

The vaccines **must not be:**

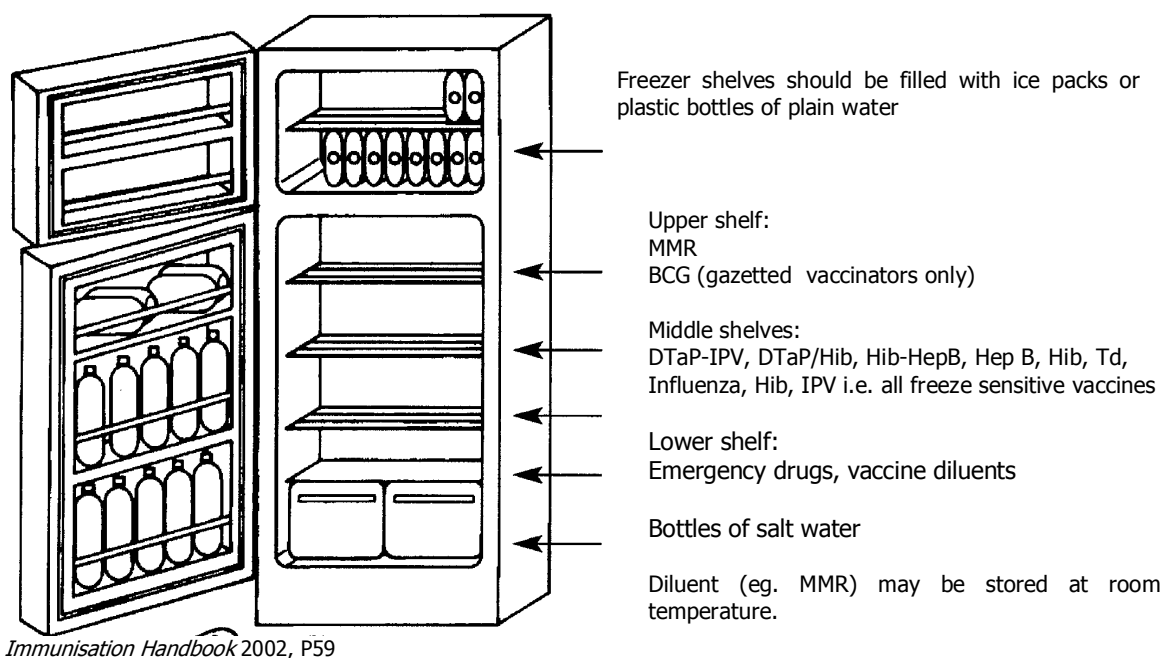
- Stacked against the walls of the refrigerator
- Stacked to the top of each shelf
- Placed by the rear freeze plate or icebox of the refrigerator
- Placed in the bottom of the refrigerator
- Placed in the refrigerator door

- ii) If using a pharmaceutical specific refrigerator the amount of vaccine stored can be increased, providing the vaccines **are not:**

- Stacked against the walls of the refrigerator
- Stacked to the top of each shelf

A.4.3 Vaccines should be stored according to temperature sensitivity eg. MMR, (heat sensitive) upper shelf of the monitored section, DTaP-IPV, DTaP/Hib, Hib-HepB, HepB, Hib, HepB, DT, Td, Influenza, Hib, IPV i.e. all freeze sensitive vaccines on middle shelves, emergency drugs on the lower shelf.

Figure 2.6: How to stock a vaccine refrigerator



- A.4.4 To avoid overstocking, there should only be sufficient vaccine stock for six weeks or less. Each practice (provider) is entitled to two vaccine deliveries per month.
- A.4.5 When restocking, the newer vaccines should be placed behind current stock to ensure a rotation of stock.
- A.4.6 All vaccines should be stored in an orderly manner with batch and expiry date within easy view.
- A.4.7 Temporary vaccine storage in insulated containers must continue to maintain the +2°C to +8°C temperature range. (Refer to Appendix 3)
- A.4.8 The state of any monitors provided must be noted before vaccines are used, recorded on the Monitor Record Card and the Monitor Card then returned to the address on the back of the card.

A.5. MONITORING AND MAINTAINING CORRECT STORAGE TEMPERATURES

- A.5.1 In workplaces where there are part time staff, at least two people should be responsible for vaccine storage and temperature monitoring.
- A.5.2 The refrigerator temperature must be monitored and documented each working day, preferably at the same time each day and by the same person or backup person in each workplace. During holiday periods the refrigerator temperature must be monitored and documented on each day the workplace is open.

- A.5.3 Each refrigerator must have a refrigerator temperature recording device that measures the current temperature as well as the minimum and maximum temperatures reached over any given time.

For information on types of refrigerator temperature recording devices or assistance in reading temperature-recording devices and in obtaining temperature recording charts, contact your Local Immunisation Coordinator or the Immunisation Advisory Centre.

- A.5.4 Grassby (1993) suggests daily temperature readings should be taken alternating between the sections of the refrigerator cabinet being used, to confirm the mean temperature profile together with cyclical temperature fluctuations.

Because providers do not limit the storage of vaccines to the only that area of the refrigerator being monitored, by only monitoring only one section of the refrigerator cabinet means that while the temperature in that section may be acceptable, vaccines stored in another part of the refrigerator may be damaged.

- A.5.5 If using an electronic minimum-maximum thermometer, the probe should be placed inside vaccine packaging, as this will allow the probe to measure the air temperature closest to a vaccine vial i.e. the probe should be placed within a sealed small vaccine box (eg. Hib), that contains the vaccine vial and data sheet. It is suggested the box be taped to the refrigerator shelf.
- A.5.6 If using a conventional (analogue) mercury minimum-maximum thermometer, it should be placed upright.
- A.5.7 In the event of the thermostat dial having to be altered, this should only be done by the person responsible for the refrigerator temperature monitoring. Changes to the thermostat setting should be recorded along with the minimum-maximum recordings.
- A.5.8 An electronic temperature-logging device should be used to independently check (audit) refrigerator performance, thermometer accuracy and correct monitoring, not less than every 6 months and should cover both summer and winter periods.

It is recommended that electronic temperature logging devices are independently calibrated on an annual basis - providers should inquire as to whether this has occurred.

Grassby (1993) suggests calibrated thermocouples (electronic data loggers in the New Zealand situation) at three locations within the refrigerator cabinet, to confirm the mean temperature profile together with cyclical temperature fluctuations.

- A.5.9 Reconstituted MMR and BCG must be protected from heat and exposure to light. Once reconstituted ideally it should be used immediately, however may be kept for up to 8 hours provided it is protected from heat (stored at +2°C to +8°C) and light.
- A.5.10 Refrigerator door opening should be kept to a minimum and the door should be closed immediately upon removing the vaccines required. A label on the refrigerator to this effect is recommended.

Eg.



- A.5.11 All vaccinators should have access to the Ministry of Health *Immunisation Handbook* 2002. The table on P62 lists the recommendations for use of vaccines exposed to temperatures outside +2°C to +8°C.

TABLE 2.7: Recommendations for the use of vaccines exposed to temperatures outside 2–8°C

Vaccine	Exposure to temperatures below 0°C	Exposure to temperatures between 8°C and 25°C
MMR, Rubella	Use	< 24 hours : Use 24–72 hours : Use within 3 months ≥ 3 days : Do not use
BCG	Use	< 5 days : Use ≥ 5 days : Do not use
DTaP, DTaP/Hib, DTaP-IPV	Do not use	< 5 days : Use ≥ 5 days : Do not use
DT, Td, Hib-hepatitis B, hepatitis B, Hib, IPV, influenza and PPD	Do not use	< 5 days : Use ≥ 5 days : Do not use

Consult with the local immunisation co-ordinator, Medical Officer of Health or Public Health Service before discarding any vaccines.

Immunisation Handbook 2002, P62

- A.5.12 Any sudden variations in refrigerator temperature or in the event of the refrigerator temperature being recorded out of the recommended +2°C to +8°C, the Local Immunisation Coordinator or IMAC should be contacted for advice and support. (Refer to Appendix 4)

A.6. VACCINE TRANSPORTATION

- A.6.1 Only insulated containers proven through electronic temperature logging as reliable in maintaining the recommended temperature of +2°C to +8°C, should be used to transport or temporarily store vaccines (eg. in the event of a power or equipment failure). Examples are solid wall chillybins,

double walled chillybins, foil lined Styrofoam containers and the cardboard box method used by Zuellig Pharma. (Refer to Appendix 3)

- A.6.2 When transporting vaccines, a temperature-monitoring device should be placed with the vaccines during this time.
- A.6.3 The size of the insulated container used should be appropriate for the volume of vaccine to be transported. Contact your Local Immunisation Coordinator for advice regarding size of insulated containers in relation to the volume of vaccine to be transported or temporarily stored.
- A.6.4 Ice packs need to be frozen for at least 2 days before being used for transporting vaccines. When placing ice packs in the freezer, set them on their edge and allow space between the ice packs, to ensure even freezing.
- A.6.5 The number and sizes of icepacks must be appropriate to the size of the insulated container used and ensure the vaccines will remain at the recommended +2°C to +8°C storage temperature through out their journey (the bottle shaped 35mm thick icepacks are recommended as they take longer to thaw)
- A.6.6 Prior to placing the icepacks in the insulated container, ensure they are frost-free (ice no longer forms on their surface).
- A.6.7 Place shredded paper in the bottom of the insulated container, then place the vaccine in such a way that the most heat sensitive are nearest the icepacks and the most freeze sensitive are furthest away from the icepacks.
- A.6.8 Separate the icepacks from the vaccine by using shredded paper or a sheet of 10mm thick polystyrene sheeting, to ensure the vaccine will not be frozen by contact with the icepacks.
- A.6.9 Secure the lid / top in place eg. Using adhesive tape.

This method has been demonstrated to keep the temperature within +2°C to +8°C for up to 5 hrs while allowing the insulated container being opened briefly, up to 4 times. Opening more frequently than this will affect the length of time the vaccines can be kept in the container.

A.7. VACCINE DISPOSAL

- A.7.1 Any unwanted, discontinued or expired vaccine or vaccine subjected to thermal insult, should be returned to Zuellig Pharma, **clearly labelled** with the Zuellig Pharma pink / red 'Vaccines for Destruction' sticker attached. (Available from your Zuellig Pharma distributor)
- A.7.2 Vaccines for destruction should be clearly marked and packed using standard health and safety precautions that apply to medical sharps waste eg. Approved sharps container, or insulated container in which the vaccines were delivered.

No syringes or needles should be enclosed other than unused prefilled syringes.

- A.7.3 Vaccines for destruction must be correctly disposed of (crushing incineration) as per requirements under the Resource Management Act. (This is undertaken by authorised agents only).

A.8. NATIONAL COLD CHAIN AUDIT

An ongoing (continual) national audit of the Cold Chain will be undertaken using thermochromic temperature monitors. The audit will cover the chain from the National Vaccine Store (NVS) through to the provider.

Appropriate ongoing education will be provided for local immunisation providers, to ensure understanding in how to read (interpret) and record the state of the monitoring devices.

- A.8.1 Heat-sensitive and freeze-sensitive monitors attached to Monitor Record Cards will be included with some of the vaccines arriving at the Providers.
- A.8.2 On unpacking, the monitors must remain with the vaccine they arrived with. The state of the monitors when the vaccine is unpacked must be noted and recorded on the Monitor Record Cards.
- A.8.3 The monitors must stay with the vaccines they were originally received with, until such time as all the vaccines in the pack are used.
- A.8.4 When the last of the vaccines in a pack are used, the state of any monitor must be noted and recorded on the Monitor Record Cards.
- A.8.5 All completed Monitor Record Cards must be returned to the address on the back of the card.

B: REGIONALLY

B.1. REGIONAL DISTRIBUTORS' RESPONSIBILITIES

- B.1.1 The distributor's responsibilities commence on receipt of vaccines from the National Vaccine Store (NVS) by checking that vaccines arrive correctly packed and in good condition, and end when vaccines are received at general practices / vaccination providers.
- B.1.2 The distributor will take all due care to minimise the wastage of vaccines.
- B.1.3 The distributor is responsible for managing vaccine stock in such a way that the length of time a vaccine is in the cold chain is kept to a minimum.
- B.1.4 The distributor is responsible for recording all vaccine batch numbers and the location of where they are dispatched.
- B.1.5 The distributor is responsible for advising all immunisation providers how vaccine orders will be received eg. By faxing order form to your Zuellig Pharma distributor.
- B.1.6 The distributor is responsible for advising all immunisation providers of the order and delivery timetables for their locality.
- B.1.7 The distributor must be active in communicating with all immunisation providers any changes to vaccine brands, presentation or delivery systems.
- B.1.8 The staff member(s) responsible for the service must have extensive knowledge / in-depth understanding of the cold chain system by undertaking appropriate training.
- B.1.9 The person(s) involved in transporting the vaccines must have complete understanding of cold chain requirements, in particular the importance of deliveries arriving at their destination within the designated 'safe window' period, to ensure vaccines are not compromised.

The Ministry of Health in conjunction with Zuellig Pharma determines the 'safe window' period.
- B.1.10 The distributor must have documented protocols for the storage and distribution of vaccines, and the management of consignments that fall outside specifications.

B.2. RECEIPT AND STORAGE OF VACCINES AT THE REGIONAL STORE.

- B.2.1 The cool unit must be of sufficient size to accommodate vaccine storage requirements without exceeding 50% of the unit's storage capacity. The unit may be purpose built or commercially manufactured, however it must be located internally within the premises/building.
- B.2.2 The unit door should have a heavy-duty latch type fastening or if reliant on a vacuum seal only, the door should be secured with a locking mechanism.
- B.2.3 The room that the cool unit is in must be of sufficient size and must be ventilated, as the efficiency of refrigeration equipment declines with high ambient temperatures.
- B.2.4 To ensure sufficient ventilation around the condenser of the unit, it should be placed at least 10 cm away from walls and other equipment.
- B.2.5 The cool unit should preferably be permanently wired into the wall outlet, to overcome the risk of deliberate or accidental disconnection.

- B.2.6 All vaccines must be unpacked and refrigerated immediately upon delivery.
- B.2.7 Vaccines must not be stacked so high as to impede the flow of air in the unit.
- B.2.8 The state of any cold chain monitors must be noted and recorded when the vaccine is unpacked. The state of the monitors must be recorded on the accompanying Monitor Record Card. The monitors must remain with the vaccine they arrived with.
- B.2.9 Vaccines must be stored in an orderly manner with different batches of the same vaccine clearly delineated. Vaccines should be stored with the batch number and expiry date label showing.
- B.2.10 Vaccines must be distributed using a lot control system i.e. short dated vaccines will be dispatched first. Vaccination providers should be contacted and invited to reduce their order if the vaccine has a short time to expiry.
- B.2.11 Any compromised or damaged vaccine returned from providers must be accepted and correctly disposed of (crushing incineration) as per requirements under the Resource Management Act.
- B.2.12 Unwanted or compromised vaccines for disposal must be collected from providers, once a month.

B.3. VACCINE DISTRIBUTION AND TRANSPORTATION

- B.3.1 Vaccines must be packed on a designated bench adjacent to the cool unit.
- B.3.2 Vaccines must be selected and packed immediately prior to dispatch.
- B.3.3 Any cold chain monitors stored with the vaccine must be included with the vaccine when it is issued from the store. The Monitor Record Card must be filled in before the monitors are packed. The monitors must be appropriately placed in the load to ensure that heat-sensitive monitors are likely to be exposed to temperatures as warm as the vaccines and freeze-sensitive monitors to temperatures as cold as the vaccines. However, the monitors must stay with the vaccines that they were originally received with.
- B.3.4 An appropriate sized cardboard box / chilly bin should be used for the amount of vaccine to be distributed.
- B.3.5 The cardboard box / chilly bin should contain the appropriate number of icepacks for its size and to ensure the vaccines will remain at the specified +2°C to +8°C storage temperature throughout their journey.
- B.3.6 If using chilly bins or cardboard boxes, shredded paper / polystyrene chips should be placed in the bottom of the chilly bin / cardboard box, then the required vaccine placed in such a way that the most heat-sensitive are nearest the icepacks and the most freeze-sensitive furthest away. The icepacks will then be separated from the vaccine using sufficient shredded paper / polystyrene sheeting to ensure the vaccine will not be frozen by exposure to the icepacks. The chilly bin / cardboard box lid should be taped in place and a 'refrigerate, do not freeze' label with the date and time the vaccines were packed, placed on the lid. (See Appendix 3).
- B.3.8 The courier or delivery agent must collect and distribute the vaccine orders to providers, within the four-hour delivery criteria (or negotiated alternative criteria).

B.4. TEMPERATURE CONTROL AND MONITORING

- B.4.1 The cool unit must be equipped with an automatic recording device, capable of continuous or intermittent temperature monitoring. There must be an automatic alarm system fitted to the device that will alert staff whenever the temperature of the unit is outside the safe limits.

- B.4.2 Reliable procedures must be in place to protect against failure, twenty-four hours a day and seven days per week.
- B.4.3 In the event of failures where vaccines have been compromised or difficulties/ recurrent episodes where temperatures fluctuate outside of +2°C to +8°C, the Ministry of Health & Regional Immunisation Coordinator must be notified.
- B.4.4 There should be at least one temperature sensor located in a position, which ensures the most accurate overall temperature control. The number of sensors will depend on the size of the cool unit.
- B.4.5 The temperature display must be checked each day at the commencement of work and immediately prior to leaving, the current minimum and maximum temperatures reached which will be recorded in a temperature log.
- B.4.6 An audit of the effectiveness of the vaccine transportation method should occur on a minimum six monthly basis with an electronic temperature-monitoring device. Audit needs to be performed both in summer and winter.

B.5. MAINTENANCE

- B.5.1 There must be a standby refrigeration system available or standby electricity supply in the event of mechanical failure or power failure.
- B.5.2 The refrigerators that the vaccine is stored in must have a regular programme of maintenance, calibration of the temperature measuring devices, and checks of back-up and alarm systems.
- B.5.3 Any abnormal events must be recorded in the maintenance log eg. Alarm activation.
- B.5.4 If applicable, the unit should be defrosted when ice greater than 1cm thick builds up on the iceplate(s) or at six monthly intervals.

B.6. NATIONAL COLD CHAIN AUDIT

An ongoing (continual) national audit of the Cold Chain will be undertaken using thermochromic temperature monitors. The audit will cover the chain from the NVS through to the provider.

Appropriate ongoing education will be provided for regional distribution staff to ensure understanding in how to read (interpret) and record the state of the monitoring devices.

- B.6.1 Heat-sensitive and freeze-sensitive monitors attached to Monitor Record Cards will be included with some of the vaccines arriving at the Regional Stores. Each Regional Store should receive more than one of each type of monitor per delivery.
- B.6.2 On unpacking, the monitors must remain with the vaccine they arrived with. The state of the monitors when the vaccine is unpacked must be noted and recorded on the Monitor Record Cards.
- B.6.3 Any cold chain monitor stored with a vaccine must be included with the vaccine when it is issued from the store. The Monitor Record Card must be filled in before the vaccine is packed for delivery. The monitors must stay with the vaccines they were originally received with.

C: NATIONALLY

C.1. NATIONAL VACCINE STORE'S RESPONSIBILITIES

C.1.1 The National Vaccine Store (NVS) is responsible for obtaining and supplying, through regional distributors, all vaccines (except influenza vaccine) required for the national immunisation schedule in New Zealand.

The NVS is also responsible for providing advice on vaccines and the cold chain to the Ministry of Health, regional distributors, immunisation coordinators, healthcare providers, and other agencies on request.

C.1.2 The NVS's responsibilities commence with the establishment of contracts for the supply of vaccines. NVS's responsibilities for a vaccine end when that vaccine is delivered to regional distributors.

C.1.3 The NVS is responsible for storing and distributing the vaccine in accordance with the *New Zealand code of good manufacturing practice for manufacture and distribution of therapeutic goods*,¹ and keeping the vaccine at its recommended storage temperature during both storage and transport.

C.1.4 The NVS will take all due care to minimise the wastage of vaccines.

C.1.5 The NVS is responsible for managing vaccine stock in such a way that the length of time the vaccine is in the cold chain is kept to a minimum.

C.1.6 The NVS is responsible for recording all vaccine batch numbers and the location to where they are dispatched.

C.1.7 The NVS must advise regional distributors of:

- The vaccines available from the NVS. This advice should include information on the brands, presentations, and pack sizes of the vaccines
- The procedure for ordering vaccine from the NVS
- The turnaround for orders
- Any changes in the vaccines, ordering procedure, and turnaround times

C.1.8 The staff of the NVS must be fully trained in the procedures of the Store and the cold chain.

C.2. TRANSPORT OF VACCINES TO NEW ZEALAND

C.2.1 All vaccines used in the national immunisation schedule must have ministerial consent to be distributed in New Zealand. To gain this consent, manufacturers have to demonstrate that they comply with good manufacturing practice, which should give reasonable assurance of the quality of all their processes, including storage and shipping.

C.2.2 All vaccines must be shipped by air to New Zealand, and packed and transported so that the vaccine is maintained at its recommended storage temperature for the entire journey.

C.2.3 Cold chain monitors, capable of indicating whether the recommended storage temperature has been maintained during transport, must be included with all vaccine shipments. Temperature data loggers may be used as an alternative to or in addition to cold chain monitors.

Each insulated shipper must contain a heat-sensitive monitor to detect temperatures above 10°C, and, if the vaccine is freeze-sensitive, a freeze-sensitive monitor to detect temperatures below 0°C.

- C.2.4 The monitors must be correctly placed in the shipper. The heat-sensitive monitor should be placed in the part of the shipper likely to experience the warmest temperatures. Similarly, the freeze-sensitive monitor should be placed in the part likely to be the coldest.
- C.2.5 The shippers must be clearly labeled to indicate the temperature sensitivity of the contents. The labeling must also indicate the temperature the vaccine is to be kept at during any storage in transit.
- C.2.6 Before shipping, manufacturers must advise the NVS of the shipping details, including the date the shipment is due in Wellington. The NVS must contact the clearing agents and ensure that they have details of the shipment, are aware of the storage requirements of the vaccine, and have made arrangements to deliver the vaccine to the NVS.
- C.2.7 These specifications for the shipment of vaccines to New Zealand must be included in contracts for the supply of vaccines.
- C.2.8 Any vaccine shipments or part-shipments, for which the cold chain has been broken or not adequately monitored, must be rejected.

C.3. RECEIPT AND STORAGE OF VACCINES AT THE NATIONAL VACCINE STORE

- C.3.1 Written procedures for the receipt and storage of vaccines must be included in the NVS's standard operating procedures.
- C.3.2 All vaccine must be unpacked and refrigerated immediately it is delivered. If the vaccine is to remain in the insulated shippers during storage, the icepacks must be removed before the shipper is placed in the refrigerator and the lids of the shippers should be left ajar for at least 48 hours to allow the vaccine to equilibrate to refrigeration temperature as rapidly as possible.
- The condition of the icepacks must be noted and recorded on the clearance documentation.
- C.3.3 The position and state of the cold chain monitors when the vaccine is unpacked must be noted and recorded on the clearance documentation. In addition, the state of the heat-sensitive monitors must be recorded on the accompanying Monitor Record Card. The heat-sensitive monitors must remain with the vaccine that they were shipped with.
- C.3.4 The refrigerators that the vaccine is stored in must:
- Have continuous temperature monitoring and recording, with an alarm system linked to a 24 hour response service
 - Have back-up power, refrigeration and air-circulation systems
 - Have a regular programme of maintenance, calibration of the temperature measuring devices, and checks of back-up and alarm systems.
- C.3.5 In addition to the continuous temperature recording, the staff of the NVS must check and manually record the temperature of the refrigerators three times a day. If the temperature is consistently running outside $5^{\circ}\text{C} \pm 1^{\circ}\text{C}$, the engineer must be called to check the refrigeration system and make an adjustment to bring the temperature nearer the 5°C optimum.

After-hours, the security staff must note and manually record the temperature of the refrigerators during each of their scheduled visits.

If the temperature is $\leq 2^{\circ}\text{C}$ or $\geq 8^{\circ}\text{C}$, action must be immediately taken to correct the temperature. The Vaccine Scientist must be advised and decide if vaccine potency has been compromised.

- C.3.6 The NVS must have a contractual arrangement with a refrigeration service company to provide a 24-hour callout service.

C.4. TRANSPORT OF VACCINES BETWEEN THE NATIONAL VACCINE STORE AND REGIONAL STORES.

- C.4.1 Written procedures for the transport of vaccines between the NVS and regional stores must be included in the NVS's standard operating procedures.
- C.4.2 Vaccine must be packed as quickly as possible, and large quantities of vaccine must not remain unrefrigerated while awaiting packaging.
- C.4.3 Chilly bins used to transport vaccine must have been tested and demonstrated to be capable of keeping vaccine cool for the standard time that the vaccines are in transit.
- C.4.4 When a chilly bin is packed with more than one type of vaccine, the relative heat and freeze-sensitivities of the different vaccines must be taken into account in the placement of the vaccines relative to the icepacks.
- C.4.5 Before icepacks are placed in the chilly bin, they must be warmed until frost no longer forms on their surface (when frost stops forming on the surface, the temperature at that point is approximately 0°C). The icepacks must be separated from the vaccine with sufficient polystyrene sheeting to insulate the vaccine against freezing.
- C.4.6 Any heat-sensitive monitors stored with the vaccine must be included with the vaccine when it is issued from the NVS. The Monitor Record Cards for the heat-sensitive monitors must be filled in before packing. The monitors must be appropriately placed in the load to ensure that they are likely to be exposed to temperatures as warm as the vaccine. The monitors must stay with the vaccine that they were originally received with.

When vaccine is being dispatched that has heat-sensitive monitors included, freeze-sensitive monitors must also be included with that vaccine issue. The Monitor Record Cards for the freeze-sensitive monitors must be filled in before packing. The monitors must be appropriately placed in the load to ensure that they are exposed to temperatures as cold as the vaccine.

- C.4.7 Specifications for the conditions, in particular, temperatures and maximum transit time, must be included in the service agreement with the courier company that ships the vaccines. Regional vaccine stores receiving the vaccine must be advised of the time by which vaccine shipments should be delivered.

C.5. NATIONAL COLD CHAIN AUDIT

An ongoing (continual) national audit of the Cold Chain will be undertaken using thermochromic temperature monitors. The audit will cover the chain from the NVS through to the provider.

Appropriate ongoing education will be provided for regional distribution staff and local immunisation providers, to ensure understanding in how to read (interpret) and record the state of the monitoring devices.

- C.5.1 Heat-sensitive monitors to detect temperatures above 10°C, and freeze-sensitive monitors to detect temperatures below 0°C, will be placed with vaccine shipments arriving at the NVS. The monitors will be attached to Monitor Record Cards.
- C.5.2 On dispatch of these vaccines the state of the monitors will be noted and recorded on the Monitor Record Cards.

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APPENDICES

- Appendix 1: Information regarding domestic and pharmaceutical type refrigerators, digital minimum-maximum thermometers and electronic data loggers
- Appendix 2: Medicines Act: Storage and delivery of medicines
- Appendix 3: Vaccine transportation
- Appendix 4: Key contacts

APPENDIX 1: INFORMATION REGARDING DOMESTIC AND PHARMACEUTICAL REFRIGERATORS, DIGITAL MINIMUM MAXIMUM THERMOMETERS & ELECTRONIC DATA LOGGERS

Refrigerators:

Current practice is to use domestic refrigerators for the storage of vaccines. A domestic refrigerator is designed to perform multiple storage functions from freezing through to provisions of various temperature zones within the refrigerator cabinet. Because the temperature tolerances for food are not so critical, provision is made for storage of product in doors etc. to maximise the utilisation of available space.

Types of domestic refrigerators commonly used for vaccine storage:

1. Multi-flow or fan forced (frost free) type domestic refrigerators. This type of refrigerator directs moisture free sub zero air from the freezer compartment throughout the food compartment. The air in the middle section of the main refrigerator compartment routinely falls below 0°C and may even fall as low as -7°C. This type of refrigerator always has two thermostat controls – one controls the freezer temperature and the other controls the volume of freezing air that enters the main refrigerator compartment.
2. Cyclic defrost type domestic type refrigerators. With cyclic defrost refrigerators a blanket of cold air flows from the cooling plate and circulates downward through the refrigerator compartment. The fresh food compartment defrosts automatically, by natural warming of the cabinet during the 'off' cycle or with a small electric heater on the evaporator plate, which can produce wide fluctuations in the internal temperatures.

Pharmaceutical specific refrigerators:

1. Use a direct airflow cooling system to maintain a standard operating temperature of +4 to +5°C.
2. Return the internal cabinet to required temperatures as quickly as possible after interruptions such as door openings.
3. Use a defrosting system that minimises the likelihood of "icing up" and is compatible with the maintenance of required internal temperatures.
4. Use an internal design that promotes an even distribution of temperature throughout
5. Frequently have an internal temperature monitoring device / system

Refrigerator size:

The Medicines Act 1981:47 Storage And Delivery Of Medicines (Cf.1960, No 97, s.25; 1969, No.44, s.6), requires each provider to have a refrigerator designated for the storage of vaccines. Food is not to be stored in the 'for vaccines only' refrigerator.

If using a domestic type refrigerator the amount of vaccine stored should only take up to 50% of the refrigerator's storage capacity, and only the monitored section of the refrigerator should be used due to the variable temperature zones within a domestic type refrigerator cabinet and because the temperature gradient increases in proportion to the degree of packing. (Grassby, 1993)

If using a pharmaceutical specific refrigerator the amount of vaccine stored may be able to be increased, providing the vaccines are not stacked against the walls of the refrigerator or to the top of each shelf and there is sufficient air circulating.

If using a domestic type refrigerator, the average general practice immunisation provider will require a refrigerator of approximately 180 - 200 litre capacity to meet the Grassby (1993) and WHO recommendations. Practices with multiple general practitioners may require larger refrigerators.

An under bench domestic type refrigerator is approximately 140 litres and therefore is of insufficient size for the average general practice immunisation provider. This type of refrigerator is only suitable for a sole practitioner practice (provider).

Digital minimum-maximum thermometers:

Many providers have moved to digital minimum-maximum thermometers as they are considered more user friendly as they are considered easier to read, thereby reducing the potential for reader error.

There are a number of digital minimum-maximum thermometers available and most have the following characteristics in common:

1. The manufacturers' acknowledge they are a low cost means of monitoring refrigerator ambient air temperatures
2. The manufacturer's guarantee applies for one year only
3. Their accuracy at 0°C ranges from +/- 0.5 to 1.0°C
4. The battery requires replacing yearly (one model) to two yearly (three models)
5. The manufacturers' consider their lifespan to be in the vicinity of three years if used correctly – after this time the accuracy range is likely to decrease due to the electronic circuitry and battery degrading.

Given the accuracy of digital minimum-maximum thermometers ranges from +/- 0.5 to 1.0°C and the full spectrum of this range is likely to be found within a single manufacturing run, providers should ice point the thermometer following purchase and before being used, in order to know where within the accuracy range that particular thermometer falls.

Ice pointing refers to ability of the thermometer to return to 0°C when the probe is placed in dry chipped ice.

It is recommended that the provider regularly ice points the digital minimum-maximum thermometer(s) eg. At least three monthly.

For information and assistance regarding domestic and pharmaceutical refrigerators, digital minimum thermometers and instructions for how to ice point the digital minimum-maximum thermometer, contact the manufacturer, Local or Regional Immunisation Coordinator or IMAC.

Electronic Data Loggers:

Data loggers are used by Local Immunisation Coordinators to assist practices (providers) in managing their cold chain. Some Independent Practitioner Associations (IPAs) and Primary Health Organisations (PHO's) have made electronic data loggers available for their practices.

There are three brands of electronic data loggers used by Immunisation Coordinators and IPAs / PHOs, which have the following characteristics in common:

1. The manufacturer's guarantee ranges from one through to three years
2. Their accuracy at 0°C ranges from +/- 0.2 to 0.3°C between -10 to +70°C
3. Two manufacturers' recommend the battery be replaced 2 yearly
4. The manufacturers' consider their lifespan to be up to and exceeding 5 years, depending on the environment in which they are being used i.e. temperature range exposed to, sample rate / logging interval, number of uses etc and if used correctly.

All three manufacturers recommend annual calibration by an independent IANZ accredited laboratory. In addition the manufacturers support the recommendation that data loggers be ice pointed six monthly.

When purchasing an electronic data logger, it is recommended the purchaser:

1. Request a manufacturers certificate of accuracy – this may be an in-house certificate or some manufacturers provide an IANZ (internationally standards) certificate of accuracy.
2. Ice point the data logger following purchase and before being used, in order to know where within the specified accuracy range that particular logger falls, given the accuracy of data loggers ranges from +/- 0.2 to 0.3°C and the full spectrum of this range is likely to be found within a single manufacturing run.

Following purchase data loggers should be ice pointed six monthly and sent for annual calibration.

Grassby (1993) found the temperature gradients associated with domestic type refrigerators could increase by 8 ° Celsius after packing to 50% of the refrigerator cabinet capacity. The size and characteristics of the gradients are related to the degree of packing and the refrigerator type.

The majority of Immunisation Coordinators in New Zealand only use one data logger when undertaking routine refrigerator assessments (audits) and it is usually placed in the middle section of the refrigerator cabinet, which means only that particular section or area of the refrigerator cabinet temperature is being measured.

A small number of Immunisation Coordinators routinely use three data loggers to concurrently monitor different areas within the refrigerator and have found temperature gradients similar to Grassby's such as: -1.30 to + 7.43°C, -3.30 to + 7.33°C, +2.96 to + 9.40 °C.

Grassby (1993) recommends using calibrated thermocouples (electronic data loggers in the New Zealand situation) at three locations within the refrigerator cabinet, to confirm the mean temperature profile together with cyclical temperature fluctuations.

In light of both the Grassby research and Immunisation Coordinator findings, and the fact that providers do not limit the storage of vaccines to the only that area of the refrigerator being monitored, those responsible for undertaking the regular assessment of providers vaccine refrigerators, should give consideration to routinely monitoring not less than two different sections or areas of the refrigerator.

The difference between accuracy and resolution:

Digital minimum-maximum thermometer and data logger specification sheets include accuracy (sensor measurement) and resolution (display) specifications. They are two different things and should not be confused.

Resolution is the smallest interval measurable by the thermometer or data logger i.e. the steps indicated by the temperature table. Thermometer resolution ranges from 0.02 °C to 1.0°C and data logger resolution ranges from 0.02 °C to 0.4°C.

Accuracy is the degree of refinement in measurement i.e. what the electronics are theoretically capable of achieving if the resolution was infinitely small. Thermometer accuracy ranges from 0.5°C to 1.0°C and data logger accuracy ranges from 0.2 °C to 0.3°C.

To clarify, because a thermometer or data logger may display 0.02°C increments does not mean it is accurate to 0.02°C.

This is why manufacturers may recommend that where loggers are used in a specific situation (application) the average temperature of that application should be in the middle of the logger's range, where resolution and with it the capability of displaying an accurate value will be best.

APPENDIX 2: MEDICINES ACT

MEDICINES ACT 1981: CLAUSE 47A STORAGE AND DELIVERY OF MEDICINES

1. No person who is in possession or charge of any prescription medicine or restricted medicine shall put it:
 - a) In any cupboard, box, shelf, or other place of storage in which articles of food or drink are stored or kept for ready use; or
 - b) In any place to which young children or unauthorised persons have ready access.
2. No person shall pack any medicine, or prepare it for use, in any room, or on any table or bench, that is used for the purpose of packing, preparing or consuming any food or drink.
3. Except as otherwise provided in any regulations made under this Act, no person who is in possession, for the purposes of any business, of a prescription medicine or a restricted medicine that is kept for the time being within any building or vehicle, shall leave that building or vehicle unattended unless he has taken all reasonable steps to secure that building or vehicle, or the part of it in which the medicine is kept, against unlawful entry.
4. No person shall deliver on retail sale, or in circumstances corresponding to retail sale, any medicine otherwise than through the post or by handing it or causing it to be handed to the person, or another person reasonably believed to be acting on that person's behalf, to whom it is addressed or for whose use it is intended.
5. Every person commits an offence against this Act who, without reasonable excuse, contravenes any of the provisions of this section.

Cf.1960, No 97, s.25; 1969, No.44, s.6

APPENDIX 3: VACCINE TRANSPORTATION

Immunisation providers use insulated containers to store vaccines when:

- Transporting vaccines
- Defrosting fridges
- There is a power or equipment failure.

The temperature must be maintained between +2°C and 8°C at all times.

Only insulated containers proven through electronic temperature logging as reliable in maintaining the recommended temperature of +2°C to +8°C, should be used to transport vaccines, or other proven methods such as the cardboard box method used by the Regional Distributors'. Examples are solid wall chillybins, double walled chillybins and foil lined Styrofoam containers.

The following factors need to be considered when transporting vaccines in insulated containers:

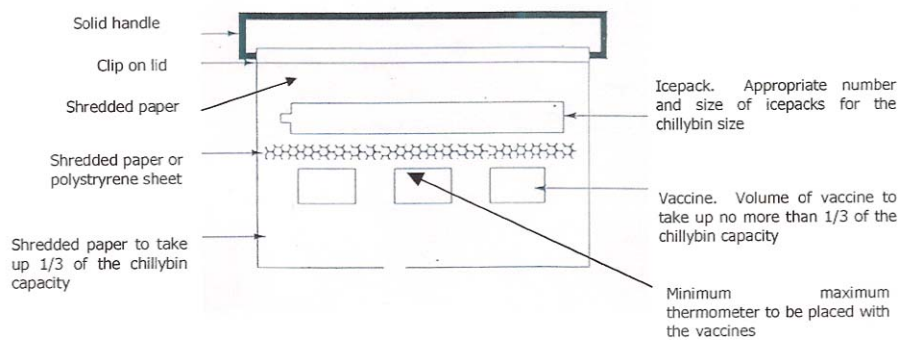
1. If using a chillybin the wall thickness (insulation) should be not less than 30mm.
2. The amount of vaccine to be transported or stored will determine the size of the insulated container used, however the volume of vaccine to be transported or stored should not exceed one third of the container's capacity.
3. The number of icepacks needed to keep the vaccines at +2°C to +8°C throughout the duration of transportation or storage. Icepacks should be of the flat "bottle" type about 35mm thick or large gel pack variety, as slimmer models tend to thaw out more quickly.

Additives to some commercial icepacks depress the melting point. There is a risk of freezing vaccines if these icepacks are not used correctly e.g. you may require less commercial icepacks to achieve the recommended temperature range of +2°C to +8°C.

4. Using a maximum-minimum digital or mercury thermometer to monitor the vaccines throughout the duration of transportation or storage.
5. The length of time the vaccines will be transported or stored.
6. The external environment the insulated container will be exposed to.

Transporting vaccines:

- Ensure the volume of vaccine for transportation or storage does not exceed one third of the insulated container capacity.
- Chill the insulated container before using, especially in the warmer seasons, by either placing it in the refrigerator or placing icepacks in it for not less than one hour
- Use the appropriate number and sizes of icepacks for the insulated container size, to ensure the vaccines will remain at +2°C to +8°C through out the duration of transportation or storage.
- Prior to placing the icepacks in the insulated container, ensure they are frost-free (ice no longer forms on their surface). This increases the temperature of the icepack to 0°C and reduces the risk of freezing vaccines.



- Put shredded paper in the bottom of the insulated container (to take up one third of the container's capacity), then place the vaccine in such a way that the most heat sensitive are nearest the icepacks and the most freeze sensitive are furthest away.
- Whenever possible, a temperature monitoring device such as a minimum-maximum thermometer or data logger should be placed with the vaccines during transportation.
- Place a layer of shredded paper or a sheet of 10mm thick polystyrene foam sheet on top of the vaccines, to ensure the vaccine will not be frozen by contact or exposure to the icepacks. If using a polystyrene foam sheet, it should sit flat on top of the vaccine and not stick on the sides.
- Place the required number of icepacks on top of the shredded paper or polystyrene foam sheet.
- Fill the remainder of the insulated container with shredded paper
- Secure the lid, if necessary tape the insulated container lid in place

Diluent can be transported or stored at room temperature.

This method has been demonstrated to keep the temperature within +2°C to +8°C for up to five hours with the insulated container being opened briefly up to four times in a warm room.

Opening the insulated container more frequently and for periods longer than one minute as well as transporting vaccines in a hot motor vehicle, are all likely to reduce the time the temperature can be maintained within the recommended range.

APPENDIX 4: KEY CONTACTS – ORGANISATIONS & PEOPLE

1. Regional Immunisation Coordinators

Northern:

Phone 09 528 3397
Cellular 025 976 971
Email: imacnth@ihug.co.nz

Midland:

Phone 06 759 0296
Cellular 025 419 727
Email: loretta.imac@xtra.co.nz

Central:

Phone 06 327 7739
Cellular 025 232 4567
Email: imaccent@ihug.co.nz

South Island:

Phone 03 684 3951
Cellular 027 230 9776
Email: imacsth@ihug.co.nz

For Local Immunisation Coordinator contact details, contact the Regional Immunisation Coordinator for your region or the Immunisation Advisory Centre.

2. Immunisation Advisory Centre (IMAC)

PO Box 17360
Greenlane
Auckland
Phone 0800 IMMUNE (0800 466863) or 09 3777 7966

3. Zuellig Pharma.

Note: Zuellig Pharma provides a vaccine distribution service only, not a technical inquiry / assistance service. All technical inquiries should be directed to the Local or Regional Immunisation Coordinator in the first instance.

Vaccine order forms can be obtained from your regional Zuellig Pharma distribution centre and faxed to the following:

Zuellig Pharma Whangarei	Fax 09 438 9681
Zuellig Pharma Distribution Auckland	Fax 09 570 1081
Zuellig Pharma Hamilton	Fax 07 849 2073
Zuellig Pharma Wellington	Fax 04 384 9794
Zuellig Pharma Christchurch	Fax 03 389 5459
Zuellig Pharma Dunedin	Fax 03 477 9751

4. The vaccine manufacturing companies also provide technical inquiry / assistance with regard to cold chain problems.

The companies supplying vaccines for the national immunisation schedule are:

- i) Glaxo Smithkline (GSK) Phone 0800 822 2463
- ii) Merck, Sharp & Dohme (NZ) Ltd (MSD). Phone 0800 500 673
- iii) Berna Biotech
NZ Agents:
CSL (New Zealand) Phone 0800 502 757
Pharmabroker Sales Ltd (PSL) Phone 0508 664 455