

Pacemaker - Temporary - for a Child

Document Type	Guideline
Function	Clinical Practice
Directorate(s)	Starship Child Health
Department(s) affected	Paediatric Intensive Care Unit (PICU) and Ward 23B
Applicable for which patients, clients or residents?	Any infant, child or young person requiring temporary pacing
Applicable for which staff members?	All clinicians in PICU and Ward 23B Starship Child Health
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Contents

1. [Purpose of guideline](#)
2. [Connecting pacing wires to the pacemaker](#)
3. [Maintenance of pacemaker function and safety](#)
4. [Prevention of complications](#)
5. [Checking pacemaker threshold](#)
6. [Checking sensing threshold](#)
7. [Removal of temporary pacing wires](#)
8. [Temporary transcutaneous pacing management](#)
9. [Anterior – posterior electrode pads application](#)
10. [Supporting evidence](#)
11. [Associated Auckland DHB documents](#)
12. [Disclaimer](#)
13. [Corrections and amendments](#)

1. Purpose of guideline

The purpose of this guideline is to facilitate the safe and effective care of an infant, child or young person requiring temporary pacing within Auckland District Health Board (Auckland DHB).

[Back to Contents](#)

2. Connecting pacing wires to the pacemaker

To ensure that the potential for electrical hazards and microshock is reduced:

- a. Gloves should be worn when handling wires;
- b. All electrical equipment should be appropriately earthed and in good working order;
- c. External terminals of the pacing wires should be correctly identified and securely inserted in the pacemaker unit;
- d. The pacemaker should be clean and dry;
- e. Unused pacing wires should be placed in a pacing wire bag, covered with a dressing, and taped to the infant, child or young person's chest;
- f. Simultaneous contact with electrical equipment and the infant, child or young person should be avoided;
- g. The appropriate method of pacing should be commenced by a suitably qualified doctor or nurse who has completed the relevant competency;
- h. A CR4552: Temporary Pacemaker Record should be commenced and all relevant information documented;
- i. An infant, child or young person should not have immersion baths or showers while attached to a temporary pacemaker.

[Back to Contents](#)

3. Maintenance of pacemaker function and safety

- a. Medical orders for pacing parameters should be recorded in the infant, child or young person's clinical record and on the CR4552: Temporary Pacemaker Record;
- b. Any alterations to pacemaker settings should be recorded in the infant, child or young person's clinical record and on the CR4552: Temporary Pacemaker Record;
- c. The infant, child or young person's ECG should be monitored continuously to detect loss of sensing, capture or pacing;
- d. All connections should be secure and checked every duty;
- e. Both epicardial and transvenous wires should be sutured in situ, covered with a dry dressing, and taped to the infant, child or young person;
- f. The pacemaker should be visible and pinned to the bed and the infant, child or young person and/or parent made aware of this;
- g. The keypad lock should be activated;
- h. The pacing threshold should be checked daily or as clinically indicated by a nurse who has completed the relevant competency (see section below);
- i. The battery should be checked every duty and replaced immediately if the battery indicator light is on;
- j. Only a suitably qualified doctor or nurse who has completed the relevant competency should initiate an alteration to the pacing mode.

[Back to Contents](#)

4. Prevention of complications

Failure to capture sense or pace

- a. If the infant, child or young person is symptomatic the situation should be treated as an emergency;
- b. The nurse in charge should be notified immediately (and the doctor if necessary) if any failure to pace, sense or capture is detected;
- c. A rhythm strip should be taken to identify the pacing problem so that appropriate treatment can be initiated;
- d. If there are no spare leads in the stock room, they should be taken from the resus trolley and replaced as soon as possible;

Infection

- a. The pacing wire sites should be reviewed daily, cleaned and redressed with a dry dressing and this should be documented in the clinical record;
- b. The wire sites should be observed for signs of inflammation/infection during the dressing procedure;
- c. The child's temperature should be recorded and documented four times a day (as a minimum) whilst the pacing wires are in situ.

[Back to Contents](#)

5. Checking pacemaker threshold

Precautions

The pacemaker threshold check should only be done when there is a staff member available who is competent with trouble shooting pacing problems, for example, a doctor, senior nurse, CNA or pacing technician.

If a child, infant or young person is suspected of having no underlying rhythm present when determining the pacing threshold, a pacing competent doctor should be present throughout the procedure.

Check pacing threshold once a shift (12 hourly) or as clinically indicated.

Asynchronous pacing (AOO mode)

- a. Ensure the child, infant or young person is lying on their bed prior to checking pacemaker threshold;
- b. Note the existing settings for rate, output, sensitivity and response to pacing;
- c. Slowly reduce Atrial output (mA) until 1:1 capture is lost as seen on the bedside monitor ECG trace;
- d. Note the infant, child or young person's underlying rate and rhythm on the bedside monitor;
- e. If arterial line in situ observe for any blood pressure changes;
- f. Increase the Atrial output (mA) to restore 1:1 capture. This value is the pacing threshold;
- g. Increase the output
 - Double the pacing threshold value with the minimum value at least 5mA
 - Ensure that the maximum atrial output is no greater than 10mA
- h. Document on CR4552: Temporary Pacemaker Record: date and time of check, threshold, output, underlying rate and rhythm, paced rate and rhythm, battery check (recording if battery changed), and sign legibly;
- i. Notify the doctor if there is a sudden increase in pacemaker threshold.

Synchronous pacing (VVI, AAI mode)

- a. Ensure the infant, child or young person is lying on their bed prior to checking pacemaker threshold;
- b. Note the existing settings for rate, output, sensitivity and response to pacing;
- c. Ensure the infant, child or young person is being paced. If not, increase pacemaker rate to 10 beats per minute above the infant, child or young person's rate, obtaining 100% capture;
- d. Slowly reduce output (mA) in the chamber being paced until capture is lost. Monitor the ECG for this. NB The pace and sense indicators should be flashing intermittently;
- e. Note the infant, child or young person's underlying rate and rhythm on the bedside monitor;
- f. Increase output (mA) in the chamber being paced to restore 1:1 capture. This value is the pacing threshold for the chamber being paced;
- g. Increase the output
 - Double the pacing threshold value with the minimum value at least 5 mA
 - Ensure that the maximum atrial output is no greater than 10mA

This safety margin should allow for threshold variation while maintaining capture.

- h. Readjust pacemaker rate back to the pre-check setting;
- i. Document on CR4552: Temporary Pacemaker Record: date and time of check, threshold, output, underlying rate and rhythm, paced rate and rhythm, battery check and/or change and sign legibly;
- j. Notify the doctor if there is a sudden increase in pacemaker threshold.

Dual chamber pacing (DOO, DVI, DDD mode)

- a. Note the existing settings for rate, output, sensitivity, AV interval and response to pacing;
- b. Ensure the infant, child or young person is being 100% paced ie there is 1:1 capture. If not, increase pacemaker rate to 10 beats per minute above the infant, child or young person's rate, obtaining 1:1 capture;
- c. Slowly reduce atrial output until 1:1 capture is lost. Increase atrial output (mA) to restore 1:1 capture. This is the atrial threshold. Note the atrial threshold. Decrease atrial output to where 1:1 capture is again lost and leave at this setting;
- d. Slowly reduce ventricular output until 1:1 capture is lost. Note the underlying rate and rhythm on the bedside monitor. Increase ventricular output (mA) to restore 1:1 capture. This is the ventricular threshold;
- e. Increase the ventricular output
 - Double the pacing threshold value with the minimum value at least 5 mA

This safety margin should allow for threshold variation while maintaining capture.
- f. Increase the atrial output
 - Double the pacing threshold value with the minimum value at least 5 mA
 - Ensure that the maximum atrial output is no greater than 10mA

This safety margin should allow for threshold variation while maintaining capture.
- g. Readjust the pacemaker rate back to the pre-check setting;
- h. Document on CR4552: Temporary Pacemaker Record: date and time of pacemaker check, atrial and ventricular threshold and output, underlying rate and rhythm, paced rate and rhythm, AV interval, battery check/change, and sign legibly;
- i. Notify the doctor if there is a sudden increase in either atrial or ventricular threshold.

[Back to Contents](#)

6. Checking sensing threshold

Precautions

The sensing threshold check should only be done when there is a staff member available who is competent with troubleshooting pacing problems, for example, a doctor, senior nurse, CNA or pacing technician

The sensing threshold will not be able to be checked if there is no underlying rhythm.

Sensing threshold is checked daily or as clinically indicated if the infant, child or young person is clinically stable.

Synchronous pacing (VVI, AAI mode)

- a. The infant, child or young person should have an intrinsic (own) rate and have remained cardiovascularly stable throughout the pacing threshold check. If there is no underlying rhythm the sensing threshold will not be able to be checked;
- b. The infant, child or young person is connected to the pacemaker and monitored on ECG;
- c. Set the pacemaker's rate 10 beats per minute (bpm) slower than the infant, child or young person's intrinsic rate (the sense indicator should flash regularly);
- d. Reduce the output (mA) to the minimum value in the respective chamber being paced to avoid the risk of competitive pacing and R on T phenomenon. This should be 0.1 mA in the Medtronic 5388;
- e. Increase the sensitivity value until the ECG indicates that the pacemaker is delivering its output asynchronously. The sense indicator should stop flashing indicating a loss of sensing and the pace indicator should start flashing. Capture is not likely to occur at the minimum output (mA) value;
- f. Decrease the sensitivity value until the ECG indicates that sensing has been restored. This value is the sensitivity threshold for the chamber being paced
 - The sense indicator should start flashing, indicating that sensing has been restored; and the pace indicator should stop flashing
- g. Set the sensitivity value to half the sensitivity threshold value. This provides a safety margin, allowing for threshold variation while maintaining sensing
For example: Sensitivity Threshold = 5.0mV
Set Sensitivity = 2.5mV
- h. Restore to the original pacemaker rate and output values;
- i. Document on CR4552: Temporary Pacemaker Record.

Synchronous dual pacing

- a. The infant, child or young person should have an intrinsic (own) rate. If there is no underlying rhythm the sensing threshold will not be able to be checked;
- b. The infant, child or young person is connected to the pacemaker and monitored on ECG;
- c. Set the pacemaker's rate 10 bpm slower than the infant, child or young person's intrinsic rate. The sense indicator should flash regularly;
- d. Reduce the output (mA) to the minimum value in the both chambers. Doing this avoids the risk of competitive pacing and R on T phenomenon. This should be 0.1 mA in the Medtronic 5388;
- e. Increase the atrial sensitivity value until the ECG indicates that the pacemaker is delivering its output asynchronously. The sense indicator should stop flashing indicating a loss of sensing and the pace indicator should start flashing. Capture is not likely to occur at the minimum output (mA) value
- f. Decrease the atrial sensitivity value until the ECG indicates that sensing has been restored. This value is the atrial sensitivity threshold for this chamber. The sense indicator should start flashing, indicating that sensing has been restored; and the pace indicator should stop flashing;
- g. Set the sensitivity value to half the sensitivity threshold value. This provides a safety margin, allowing for threshold variation while maintaining sensing
For example: Sensitivity Threshold = 2.0mV
 Set Sensitivity = 1.0mV
- h. Increase the ventricular sensitivity value until the ECG indicates that the pacemaker is delivering its output asynchronously. The sense indicator should stop flashing indicating a loss of sensing. The pace indicator should start flashing. Capture is not likely to occur at the minimum output (mA) value;
- i. Decrease the ventricular sensitivity value until the ECG indicates that sensing has been restored. This value is the ventricular sensitivity threshold for this chamber. The sense indicator should start flashing, indicating that sensing has been restored; and the pace indicator should stop flashing;
- j. Set the sensitivity value to half the sensitivity threshold value. This provides a safety margin, allowing for threshold variation while maintaining sensing
For example: Sensitivity Threshold = 5.0mV
 Set Sensitivity = 2.5mV
- k. Restore to the original pacemaker rate and output values for both chambers;
- l. Document on CR4552: Temporary Pacemaker Record.

[Back to Contents](#)

7. Removal of temporary pacing wires

When to remove

Wires are generally removed on day 4 postoperatively but may be removed earlier on the instructions of the surgeon.

Pacing wires should be removed as soon after the morning ward round as possible. Removal of wires should not be done after 1 pm, to ensure:

- Availability of a cardiac surgeon if there are any complications
- Follow-up echocardiogram or chest x-rays are able to be done and reviewed during working hours

Prior to removal

If the infant, child or young person is in PICU, ensure:

- Normal sinus rhythm
- A PATENT IV
- Normal APTT
- Normal platelet count
- Current group and hold
- As long as APTT normal, do not stop heparin infusion. If APTT abnormal, stop heparin for 2 hours and recheck APTT prior to wire removal

If the infant, child or young person is in ward 23B, ensure:

- If on warfarin, I.N.R. is ≤ 3
- Platelet count is > 100
- If on heparin infusion, stop for 2 hours prior to removal of wires
- A 12 lead ECG is completed and reviewed prior to removal
- Ensure paediatric cardiac surgeon is available in the hospital, especially at weekend

	Removal day	IV line needed prior	Group and hold required	Weekend removal
<5 kg	4 or 5	Yes	Yes	Not permitted
>5-10 kg (< 1 year)	3 to 5	Yes	Yes	Yes
>10 kg (> 1 year)	3 to 5	No	No	Yes

N.B: If <4 months of age the initial cross match will be valid

Equipment

- Dressing pack
- Suture removal blade
- Rubbish bag
- 0.9% w/v sodium chloride
- Transparent dressing
- Non sterile gloves

Preparation of the paediatric infant, child or young person

- a. Explain the procedure to the infant, child or young person and/or parents and encourage them to relax
 - If the infant, child or young person is in ward 23B, notify the play therapist of intervention and co-ordinate timing of removal. Removal is undertaken in the treatment room
 - Give sedation if necessary and as prescribed
- b. Attach the infant, child or young person to continuous monitoring for heart rate, respiratory rate and O₂ saturations;
- c. Assist the infant, child or young person to lie in a semi-recumbent position. Ensure the infant, child or young person is comfortable and safe, the procedure should require 2 nurses;
- d. Wash hands and prepare equipment;
- e. Remove plastic bag protecting the wires;
- f. Untangle and separate the wires out.

Removal method

- a. Remove skin stitches that are in place;
- b. Place gauze square over the site;
- c. If the infant, child or young person is able, ask them to take a deep breath and hold it;
- d. Hold both of the pacing wires firmly. Tug the wires to the point of tension, and then pull both wires at the same time in one continuous movement down towards the umbilicus;
- e. If undue tension is encountered and pacing wires do not remove easily, try removing them one at a time. If the tension remains unchanged, then cease attempt and contact the doctor.

Post removal

- a. Clean site and apply dressing if oozing;
- b. Check wires are intact;
- c. Calm the infant, child or young person as quickly as possible afterward eg feed cuddle;
- d. Take the infant, child or young person's apex beat, noting any abnormalities. Report any abnormalities to the doctor and same in clinical record;
- e. Instruct the infant, child or young person/parent to ensure the infant, child or young person remains resting on their bed for 20 – 30 minutes. Ensure the call bell is present and functioning;
- f. If the infant, child or young person is old enough instruct them to report any untoward feelings ie palpitations, faintness and light-headedness;
- g. The infant, child or young person should require continuous monitoring for 4 hours after removal of the wires. Document vital signs q30 minutes;
- h. Watch for signs of blood loss or tamponade (mottling, cool peripheries, and increase in heart rate). Alert the doctor and ensure a chest x-ray is done promptly and reviewed;
- i. The infant, child or young person should not be transferred for at least 2 hours post procedure to ensure consistent assessment;
- j. If the infant, child or young person is in ward 23B, an echocardiogram is done at 2 - 6 hours for effusion check and a portable chest x-ray is ordered if pleural effusion is suspected;
- k. Dispose of rubbish and wash hands;
- l. Document removal on CR4552: Temporary Pacemaker Record and clinical record.

[Back to Contents](#)

8. Temporary transcutaneous pacing management

Technique of electrically stimulating the heart externally through a set of electrode pads.

Transcutaneous pacing can be used:

In an emergency situation as a temporary solution to improve a slow heart rate resulting in inadequate cardiac output

As a temporary measure in preparation for a transvenous or permanent pacemaker

Transcutaneous pacing is only temporary: Usually less than a few hours

If requiring transcutaneous pacing – ensure referral and transfer to PHDU/PICU.

Equipment

- Philips XL Heart Start Defibrillator with Pacing Option
- Multifunction electrode pads cable
- Philips Paediatric Plus Multifunction Electrode Pads Philips
 - Adult Plus Multifunction Electrode Pads should be used for a child weighing >25 kg
 - Paediatric Plus multifunction electrode pads should be used for a child weighing < 25 kg

Preparation of a paediatric infant, child or young person

- a. Provide appropriate support to the infant, child or young person with cardiac compromise;
- b. Monitor the infant, child or young person's condition. Vital signs and take rhythm strip where time and the infant, child or young person's condition permits;
- c. Explain the procedure to the infant, child or young person and/or parents where time and the infant, child or young person's condition permits;
- d. Ensure that sedation and pain relief is given.

Method apply pacing pads

- a. Expose chest and prepare skin. Ensure skin is clean and dry; remove any substances from the skin surface (lotions, medications, sweat). Do not use alcohol or tincture of Benzoin;
- b. Open Multifunction Electrode Pad and remove protective liner to expose conductive and adhesive areas;
- c. Apply electrode to the infant, child or young person either "anterior-anterior placement or anterior - posterior placement (see accompanying picture);

- d. Do not place pads over open cuts, sores or metal objects. Where possible avoid placing over large bone structures (Scapula, spine, sternum);
- e. Apply pads separately by firmly pressing down from top to bottom in one smooth motion. Apply gentle pressure over entire surface of gel and adhesive ring to assure adhesion;
- f. Pads should not be touching one another or any other electrode;
- g. Connect electrode pads to Philips XL Heartstart defibrillator using the multifunction electrode pads cable.

Method: commence pacing

- a. Turn the pacer functionality on;
- b. Select mode
 - Clinician to select either a fixed rate pacing or demand mode pacing
 - NB: Demand (synchronous) mode is the preferred method of pacing, as it should pace only when the infant, child or young person's own rate drops below a level set on the pacer
 - Fixed (asynchronous) mode paces at the rate set by the clinician regardless of the infant, child or young person's own rate
- c. Attach both the ECG monitoring cable and the defibrillation electrode pads for both demand pacing and fixed pacing;
- d. Capture the heart
 - Start the pacer. Increase the output (mA) until pacer spikes are visible in front of each QRS complex and capture has occurred. QRS may appear wide on the ECG monitor
- e. When 1:1 capture is obtained decrease the output (mA) to the lowest level that still maintains capture;
- f. Evaluate the infant, child or young person
 - Did the infant, child or young person improve with capture? Evaluate BP, SpO₂ and SpO₂ pulse rate
 - Check the infant, child or young person has a palpable pulse
 - NB: Capture alone does not guarantee the cardiac output has improved

Troubleshooting

If the pacemaker spike is not in front of each QRS complex then consider:

- Failure to capture: Increasing the output (mA) may obtain capture. Ensure pads have good skin contact. Check correct pad placement
- Failure to sense: This occurs in demand mode only. Seen when the pacemaker discharges immediately after the infant, child or young person's own QRS complex. The pads are not

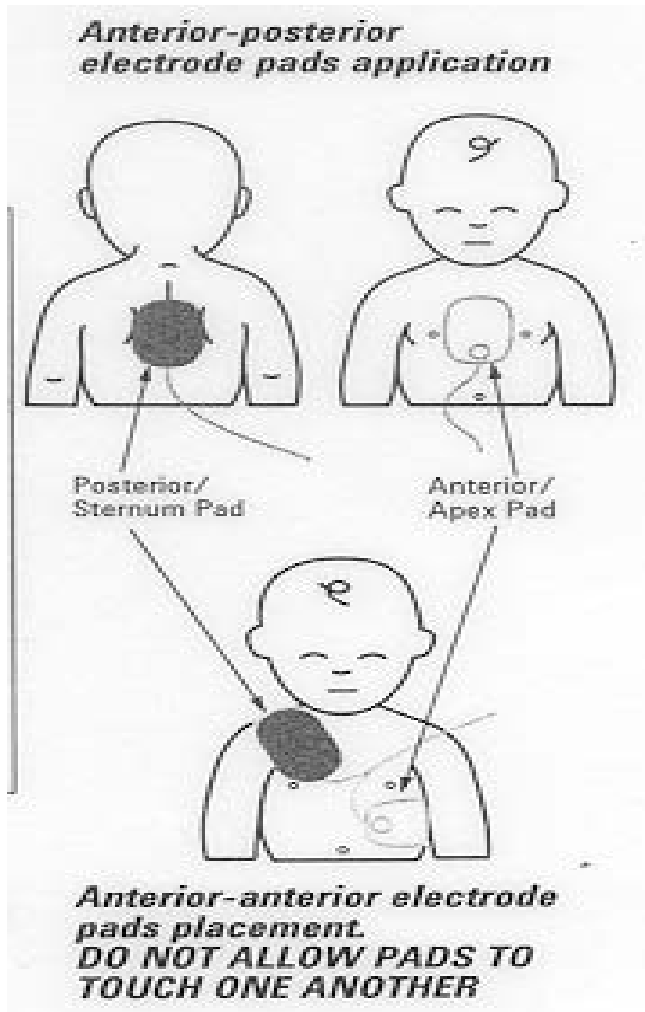
sensing the infant, child or young person's own heartbeat. Select a different monitoring lead or re-position the pads. In some instances fixed pacing may be indicated

On-going care

- a. Skin fragility and integrity
 - Replace the electrode pads after 24 hours on skin, 50 defibrillation shocks or 8 hours of transcutaneous pacing
- b. For extended periods of pacing, greater than 30 minutes, pads should be checked frequently (every thirty minutes), and replaced as necessary;
- c. Misuse or misapplication of any electrode can result in infant, child or young person burns or ineffective therapy (NB: reddening of the skin is normal);
- d. Move pad placement if the infant, child or young person's condition allows, at least every 8 hours if pacing to protect the skin;
- e. Routinely check that there is a pulse with each QRS complex;
- f. Identify the length of time the pacemaker is to be used. Transcutaneous pacing is only temporary and should be used for less than a few hours;
- g. Document on CR4552: Temporary Pacemaker Record.

[Back to Contents](#)

9. Anterior – posterior electrode pads application



[Back to Contents](#)

10. Supporting evidence

- Beery, T; Baas, L; Hickey, C. (1996) [Infection Precautions with Temporary Pacing Leads: A descriptive study](#). *Heart and Lung* 25 (3) 182-189
- Boyle, J; Rost M.K. (2000) [Present Status of cardiac Pacing: A nursing Perspective](#). *Critical Care Nursing Quarterly* 23(1) 1-19
- Cummings, C; Byrum, D. (2001) [The Beat Goes On: Cardiac Pacers – how to use them, what to know about them](#). *American Journal of Nursing* 101; 9-12 (supplement)
- Gammage, M.D. *Temporary Cardiac Pacing*. *Heart* 83(6) 715-720
- Keenon, J. (1995) Temporary Cardiac Pacing. *Nursing Standard* 9 (20) 8-14, 50-51
- Norman, E. M. (1998) [Avoiding Electrical Hazards](#). *American Journal of Nursing* 98 (6) 16GG-16HH
- Overbay, D., & Criddle, L. (2004). [Mastering temporary invasive cardiac pacing](#). *Critical Care Nurse*, 24 (3), 25-32

[Back to Contents](#)

11. Associated Auckland DHB documents

- [Medications - Administration](#)
- [Medications - Prescribing](#)
- [Pacemaker - Temporary Epicardial in CVICU](#) (adult)
- Nursing Competency - Pacing Competency

Clinical forms

- CR4552: Temporary Pacemaker Record

Equipment manual

- Medtronic 5388 Temporary Dual Chamber Pacemaker Handbook
- Phillips Heartstart Non-Invasive Pacing Application Note
- Philips Multifunction Defibrillation Electrode Pads Manufacturers Recommendations: Paediatric Plus Pads
- Philips Multifunction Defibrillation Electrode Pads Manufacturers Recommendations: Adult Plus Pads
- Philips Pads Multifunction Defibrillator Electrodes: Technical specifications

[Back to Contents](#)

12. Disclaimer

No guideline can cover all variations required for specific circumstances. It is the responsibility of the health care practitioners using this Auckland DHB guideline to adapt it for safe use within their own institution, recognise the need for specialist help, and call for it without delay, when an individual patient falls outside of the boundaries of this guideline.

[Back to Contents](#)

13. Corrections and amendments

The next scheduled review of this document is as per the document classification table (page 1). However, if the reader notices any errors or believes that the document should be reviewed **before** the scheduled date, they should contact the owner or the [Clinical Policy Advisor](#) without delay.

[Back to Contents](#)