

# MILRINONE INFUSION – MANAGEMENT

## PRACTICE GUIDELINE<sup>®</sup>

### DOCUMENT SUMMARY/KEY POINTS

- This guideline is for use in the ward and home environment.
- In most cases patients will be stabilised on the milrinone infusion in the Intensive Care Unit prior to being transferred to the appropriate ward.
- Nurses caring for patients with a milrinone infusion must be accredited to do so. Accreditation includes completing the Inotrope Infusion Learning Package in addition to practical competence, deemed by the Clinical Nurse Educator (CNE).
- Central venous access should also be considered for those who are heavily fluid restricted and where timeframe for inotropic support is likely to be extended.
- Milrinone should be administered as a continuous infusion only.
- Usual recommended concentration via central venous route is 200microg/mL.
- For heavily fluid restricted patients, with central venous access only, the maximum concentration is 800 microg/mL<sup>11</sup>
- In hospital, continuous cardiac monitoring is required during the infusion, and after the infusion is ceased, in conjunction with the treating cardiologist.
- Close observation is required post transfer out of PICU and during weaning of infusion to monitor for haemodynamic instability.
- Treatment plan and indication for home milrinone must be reviewed by the treating cardiologist as a minimum on a fortnightly basis. Results of this review should be documented in the patient's notes.
- Children requiring long term intravenous (IV) milrinone therapy for treatment of heart failure due to cardiomyopathy can safely and effectively be treated at home under the care of the HITH service

This document reflects what is currently regarded as safe practice. However, as in any clinical situation, there may be factors which cannot be covered by a single set of guidelines. This document does not replace the need for the application of clinical judgement to each individual presentation.

<b>Approved by:</b>	SCHN Policy, Procedure and Guideline Committee	
<b>Date Effective:</b>	1 <sup>st</sup> October 2023	<b>Review Period:</b> 3 years
<b>Team Leader:</b>	Network Nurse Educator	<b>Area/Dept:</b> Cardiac Services

## CHANGE SUMMARY

- Network guideline replaces the departmental Edgar Stephen Ward CHW guideline (2010-0004 v3).
- Includes the management of milrinone infusions at home

## READ ACKNOWLEDGEMENT

- All Registered Nurses involved in caring for patients with a milrinone infusion must be deemed competent in the nursing management of a milrinone infusion. See ward CNE for appropriate accreditation
- All clinical staff caring for patients requiring a milrinone infusion must read and acknowledge the practice guideline

This document reflects what is currently regarded as safe practice. However, as in any clinical situation, there may be factors which cannot be covered by a single set of guidelines. This document does not replace the need for the application of clinical judgement to each individual presentation.

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# TABLE OF CONTENTS

<b>Introduction</b> .....	<b>4</b>
<b>Pharmacology</b> .....	<b>4</b>
<b>Indications</b> .....	<b>4</b>
<b>Contraindications</b> .....	<b>5</b>
<b>Adverse Reactions</b> .....	<b>5</b>
<b>Special considerations</b> .....	<b>5</b>
<b>Interactions</b> .....	<b>6</b>
<b>Calculations</b> .....	<b>6</b>
<b>Checking order (in Hospital)</b> .....	<b>6</b>
<b>Checking order (At Home with HITH)</b> .....	<b>6</b>
<b>Administration</b> .....	<b>7</b>
Central venous administration:.....	7
<b>Observations whilst an Inpatient</b> .....	<b>8</b>
<b>Weaning Milrinone infusion</b> .....	<b>8</b>
<b>In hospital ambulation</b> .....	<b>8</b>
<b>Hospital in the Home Pathway</b> .....	<b>9</b>
Introduction.....	9
HITH Admission Criteria.....	9
HITH Inclusion Criteria .....	9
HITH Exclusion Criteria .....	10
Making a Referral to HITH.....	10
HITH Treatment Plan .....	10
Parent Education.....	11
Useful information and resources:.....	11
<b>Appendix 1: Making a referral to HITH Flowchart</b> .....	<b>12</b>
<b>References</b> .....	<b>13</b>

## Introduction

Positive inotropes are used in the management of patients whose haemodynamic stability is compromised<sup>1</sup>. Milrinone is one such agent commonly used in intensive care and appropriate designated inpatient wards. It is also used in an outpatient setting for long-term management of heart failure.

This Practice Guideline outlines the recommended management of milrinone in the ward and home settings for long term IV milrinone.

## Pharmacology

Milrinone is a phosphodiesterase type 3 inhibitor with positive inotropic and vasodilatory properties.<sup>2</sup> It causes an increase in levels of cyclic adenosine monophosphate (cAMP), the active agent that produces arterial and venous vasodilation, leading to decreased systemic and pulmonary vascular resistance, decreased left and right filling pressures, and increased cardiac output.<sup>3</sup> It also allows for increased cardiac output with a lesser effect than Dobutamine on heart rate and, subsequently, myocardial oxygen consumption.<sup>3,4,5,6</sup>

- Elimination half-life is 2-3 hours, however clearance can be variable in the paediatric population in particular in patients with acute kidney injury<sup>6</sup>.
- Steady state plasma levels are achieved after approximately 6-12 hours of infusion at an unchanged rate.
- Milrinone undergoes extensive renal clearance, caution needs to be taken in patients with decreased renal function or at risk of acute kidney injury. Doses should be titrated based on hemodynamic and clinical response rather than algorithmically based on estimated creatinine clearance<sup>6</sup>.
- Due to the longer half-life, cessation of milrinone infusion will not cause immediate haemodynamic changes.

## Indications

Specifically, milrinone is used for:

- Short term treatment of severe congestive heart failure not responding to other medical therapies (e.g. digoxin, diuretics, vasodilators including ACE inhibitors)<sup>2,6</sup>
- Low cardiac output syndrome<sup>6</sup>
- Bridging therapy to ventricular assist device implantation or cardiac transplantation<sup>7</sup>

In addition to short-term use in the peri-operative period, milrinone has been found to be useful for the medium-long term treatment of heart failure. It may be used either on its own or in combination with other inotropic medications.<sup>6</sup>

## Contraindications

- Idiopathic hypertrophic subaortic stenosis<sup>6</sup>
- Obstructive aortic or pulmonary valvular disease<sup>6</sup>
- Previous hypersensitivity to milrinone<sup>6</sup> and any of its excipients.
- Home milrinone will not be used in patients deemed unsuitable at the discretion of the treating cardiologist.

## Adverse Reactions

Include, but not limited to:

- Ventricular ectopic activity and ventricular arrhythmias<sup>3,6</sup>
  - Hypotension<sup>3,6</sup>
  - Headache<sup>6</sup>
  - Angina/chest pain<sup>6</sup>
  - Infusion site reactions<sup>6</sup>
  - Hypokalaemia, tremor and thrombocytopenia<sup>6</sup>
  - Bronchospasm and anaphylactic shock (very rare)<sup>6</sup>
- (See MIMS for full listing)

## Special considerations

- Patients must be established on the milrinone infusion in the Intensive Care Unit. Once stable, patients can be transferred to the ward in consultation with the Intensivist and Cardiologist.
- For patients previously stabilised on milrinone, consideration can be given to restarting the infusion on the ward at the discretion of the treating team(s).
- Consideration for central access should also be considered for those heavily fluid restricted and where timeframe for inotrope support is likely to be extended.
- Monitor renal function and electrolytes (especially potassium) during the infusion, reduce dose in patients with impaired renal function.<sup>6</sup>
- Patients must be deemed as suitable for home milrinone, following a psychosocial assessment, with a clearly documented treatment plan and end goal, such as a bridge to Heart Transplant.
- Treatment plan and indication for home Milrinone must be reviewed by the named cardiologist, as a minimum on a fortnightly basis. Results of this review should be documented in the patient's Electronic medical record.

## Interactions

- Avoid administration of other medications via same venous access site where possible.
  - Incompatible fluids: sodium bicarbonate<sup>6,8</sup>
  - Multiple incompatible drugs: furosemide (frusemide), ondansetron, esmolol, procainamide, phenytoin sodium, lidocaine (lignocaine), diphenhydramine, diazepam, imipenem-cilastatin<sup>6,8</sup>
- (Consult Pharmacy for further information)

## Calculations

- The weight used for dose calculation will be decided by the Cardiologist and must be listed on each order.
- The weight used to calculate the dosage should remain consistent as this will decrease the risk of errors occurring.
- Dose: 0.25-0.75 microg/kg/min titrated according to hemodynamic and clinical response.<sup>6,8</sup>

## Checking order (in Hospital)

- When in hospital the medication order is to be reviewed every 24 hours.
- Infusion syringe and line is to be changed when necessary or at least every 24 hrs.<sup>6,8</sup>
- In accordance to medication administration guideline; medication must be checked by two Registered Nurses (RNs), one of whom is appropriately accredited to prepare the infusion.
- Both RNs must calculate the correct dosage of the infusion.
- Two RNs must check the infusion against the order when handover of patient occurs.

The infusion line must be clearly labelled 'Milrinone' as per the [NSW Health Medication Handling Policy Directive \(PD2022\\_032\)](#)

## Checking order (At Home with HITH)

- As HITH RNs work alone, single IV checks are permitted.
- CADD cassettes will be labelled with Patient name, MRN, drug name (Milrinone) and drug concentration and must be changed every 24 hours.
- Dosing of home milrinone will be a stable continuous dose.

## Administration

- Milrinone must only be infused as a **continuous infusion** via a syringe driver or CADD pump. HITH patients must utilise a CADD pump.
- While an inpatient, dilution in sodium chloride 0.9% and administration via 50 mL syringe is recommended due to increased accuracy of dosage administration.
- Lines can be changed using a quick change technique – in view of the half-life, double pumping is not required.

### Peripheral venous administration:

- Maximum concentration 200 microg/mL.<sup>9,10</sup>
- Recommended method for syringe preparation is:
  - 10 mg milrinone made up to 50 mL with sodium chloride 0.9% therefore concentration = 200 microg/mL.

### Central venous administration:

- Usual recommended concentration for central venous administration is 200 microg/mL
- For heavily fluid restricted patients with central venous access only:
  - The maximum concentration for administration via central venous access device (CVAD) is 800 microg/mL.<sup>9,10</sup>
  - To minimise the risk of occlusion, the ideal total infusion rate is 5-10 mL/hr, if there is no fluid or weight-based restriction in place. An additional infusion of sodium chloride 0.9% should be infused through the same access to supplement the infusion rate up to 5 mL/ hour, (e.g. if milrinone infusion rate is 1.5 mL/hour, normal saline infusion should run at 3.5 mL/hour). An exception to this is when using a CADD pump in the home environment or to manage fluid restrictions for individual patient as discussed with the treating team.
  - Please refer to [SCHN CVAD Practice Guideline](#)

## Observations whilst an Inpatient

- In hospital continuous cardiac monitoring is required during the infusion, and after the infusion is ceased in conjunction with the treating cardiologist.
- Hourly heart rate (HR), respiratory rate (RR) and blood pressure (BP) for the first 12 hours after transfer to ward and with each rate change. Temperature should be measured 4<sup>th</sup> hourly.
- Once stable, the frequency of regular observations can be set by the treating cardiologist.
- In hospital fluid balance must be monitored strictly and patient weight must be measured daily. Monitor infusion site hourly to avoid extravasation. If extravasation occurs change to alternative site immediately.
  - See [SCHN Intravenous Extravasation - Management Practice Guideline](#)

## Weaning Milrinone infusion

- Weaning dose changes will be set by the treating cardiologist. Milrinone must never be ceased abruptly, unless indicated by the treating specialist, such as in a one way wean for end of life care. Gradual dose reduction is recommended.
- Continue cardiac monitoring and regular observations during dose reduction to monitor for haemodynamic instability, these should be continued for 6 hours post cessation.
- Once ceased disconnect the milrinone then attach a sodium chloride 0.9% infusion to continue at the same rate to clear the patient's line in accordance with the line's priming volume as documented at time of insertion. [Circulating Priming Volume \(Dead Space\)](#)
- Lock central access as per SCHN CVAD Practice Guideline.

## In hospital ambulation

- May ambulate around ward as desired and as physical condition permits.
- Ensure nurse escort and portable cardiac monitoring if the patient leaves the ward setting in discussion with the treating cardiologist.



## Hospital in the Home Pathway

### Introduction

- The Hospital in the Home (HITH) service provides acute and post-acute hospital substitution and/or hospital avoidance service.
- HITH is a network-wide service and is a part of the SCH and CHW Ambulatory Units.
- SCHN HITH Service hours are 0730 to 2130 hours, seven days per week.
- Milrinone CADD cassettes will be provided by SCH and CHW pharmacy departments on a regular and ongoing basis. These cassettes may be manufactured by the hospital pharmacy sterile suite or ordered in from an external compounding service such as Baxter. Standard orders of 7 cassettes weekly will be collected by HITH from relevant Pharmacy Department. Initial orders may require 8 cassettes in order to ensure an emergency backup cassette is available at all times. This should be rotated into use by the family or HITH to ensure the backup remains in-date.

### HITH Admission Criteria

- Admitting Medical Officer's (AMO) approval for admission and transfer to HITH
- Consent received from parents and/or carers for admission to HITH
- Presence of a carer aged 18 years or over during home visits
- Carer competency to manage the child's condition
- Phone access to parents and/or carers
- Mutual recognition of identified goals of care (parents and clinical team)
- Family have access to transport
- Medicare eligibility (Unless executive approval is given for non-Medicare eligible patients).
- Patients live within the HITH network boundary. Ronald McDonald House can be used an alternative therefore location is not solely an exclusion.
- No issues identified that can compromise staff safety during home visits

### HITH Inclusion Criteria

Children requiring long term intravenous (IV) Milrinone therapy for treatment of heart failure can safely and effectively be treated at home under the care of the HITH service.

## HITH Exclusion Criteria

- As per treating cardiologist
- Significant social issues and/or risk of non-compliance with treatment plan.
- Does not meet criteria of Home Risk Assessment (HRA)
- Does not meet the Admission to Hospital in the Home admission criteria

## Making a Referral to HITH

- Referral to be discussed with the Ambulatory Clinical Nurse Specialist 2 (CNS2) and once accepted an online referral to be placed via Powerchart.
- The process for making a referral to HITH is outlined in Appendix 1.
- HITH staff will meet the parent and/or carer to complete a 'Consent for Paediatric Hospital in the Home (HITH) Care'.
- A 'Home Risk Assessment' (HRA) is required to be completed by HITH staff prior to attending the first home visit.

## HITH Treatment Plan

- Patients will be visited on a daily basis at home.
- Medical reviews as deemed necessary by the treating team.
- Nursing care will include but is not limited to:
  - Clinical Observations (HR, RR, BP, SpO2, Temperature).
  - Weight (unless otherwise specified by the team).
  - Care of the Central Venous Access Device (CVAD).
  - Change of Milrinone CADD cassette.
  - Bloods tests as requested (taken via the CVAD).
  - Documentation and communication with the Cardiology team regarding any change in condition or new symptoms.

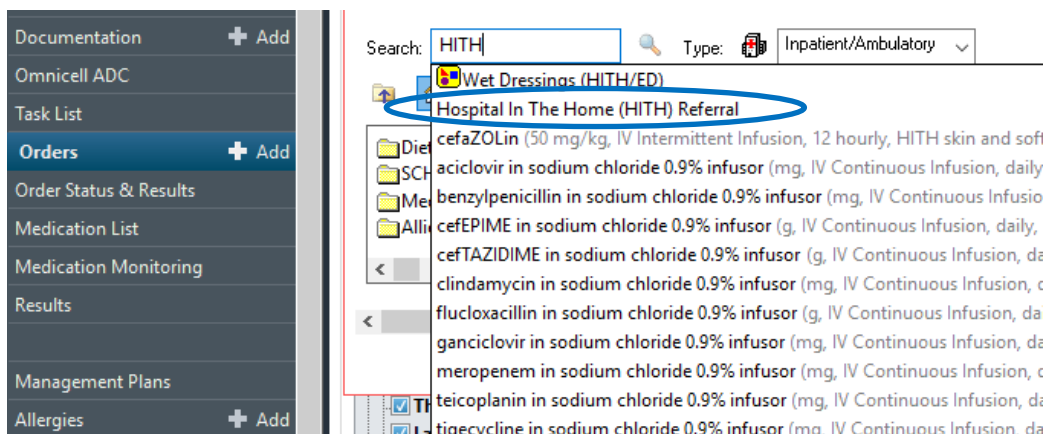
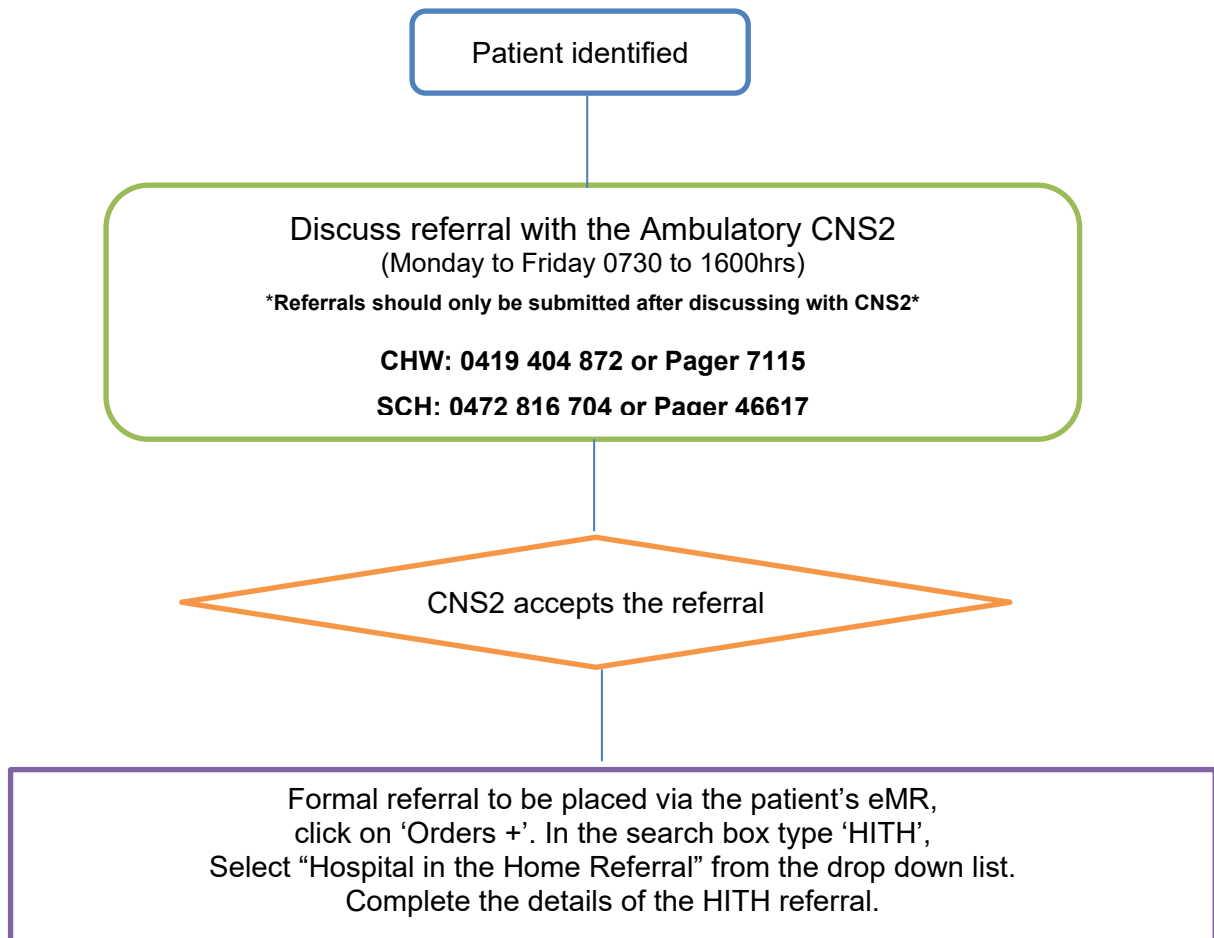
## Parent Education

- Parental education should begin as soon as HITH has been accepted.
- This will include but is not limited to:
  - Attending a weight
  - Attending a temperature
  - First Aid Training
  - Care of the CVAD
  - CADD pump education
  - Escalation plan

## Useful information and resources:

- [Admission to Hospital in the Home Service](#)
- [CVAD First Aid Kit](#) CHW
- [CVAD First Aid Kit](#) SCH

## Appendix 1: Making a referral to HITH Flowchart



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