

Alert	May cause hypotension. Caution advised when using loading dose. Reduce infusion rate for infants with renal impairment and prematurity.														
Indication	Inotrope and vasodilator for: 1. Treatment of low cardiac output and as an adjunct to inhaled nitric oxide in neonates with persistent pulmonary hypertension of the neonate. ¹ 2. Prevention of low cardiac output syndrome (LCOS) post cardiac surgery. ^{2, 3} 3. Treatment of myocardial dysfunction in neonates and children with shock particularly in context of enteroviral 71 infection. ⁴														
Action	Selective inhibitor of type 3 cAMP phosphodiesterase in cardiac and vascular muscle														
Drug type	Inotrope and vasodilator														
Trade name	Milrinone GH, Milrinone-Baxter														
Presentation	10 mg/10 mL (1000 microgram/mL) vial														
Dose	<p>≥ 37⁺⁰ weeks Corrected gestational age/postmenstrual age 0.33 – 0.75 microgram/kg/minute as continuous IV infusion</p> <p><37⁺⁰ weeks corrected gestational age/postmenstrual age) 0.2 microgram/kg/minute as continuous IV infusion.</p> <p>ANMF consensus – loading dose is not recommended in neonates due to the risk of hypotension.</p>														
Dose adjustment	Renal impairment (including hypoplastic left heart syndrome undergoing surgery) 0.2 – 0.33 microgram/kg/minute as continuous IV infusion														
Maximum dose	Term infants - 1 microgram/kg/minute Preterm infants - 0.5 microgram/kg/minute Caution – Risk of drug accumulation over time.														
Route	IV infusion														
Preparation	<p>Note: Refer to Appendix for tables to assist with concentration selection.</p> <p>Note: Use the smallest volume syringe available/suitable for drawing up the drug for the preparation. (e.g. for <1 mL draw up – use 1 mL syringe). For 10 mL syringe - Recommend using syringe that has markings at 0.2mL increments</p> <p>The standard concentrations outlined in this monograph were developed taking into consideration a minimum patient weight of 0.4 kg and a minimum infusion rate of 0.1 mL/hour.</p> <p>For patients weighing less than 0.4 kg, the standard concentrations may not permit administration at or above the minimum infusion rate of 0.1 mL/hour. In such cases, the dilution and/or concentration may require individualisation to ensure safe and accurate drug delivery.</p> <p>Weight suggestions for infusion concentrations below are a guide only. Clinicians may choose infusion concentration different to the suggested based on expected dose and the corresponding 24-hour fluid volumes.</p> <table border="1"> <thead> <tr> <th>Milrinone concentration</th><th>50 microgram/mL</th><th>100 microgram/mL</th><th>200 microgram/mL</th></tr> </thead> <tbody> <tr> <td>Infant weight (Guide Only)</td><td><1 kg</td><td>1 to 3 kg</td><td>>3 kg</td></tr> <tr> <td>0.2 microgram/kg/minute</td><td>0.24 mL/kg/hour</td><td>0.12 mL/kg/hour</td><td>0.06 mL/kg/hour</td></tr> </tbody> </table>			Milrinone concentration	50 microgram/mL	100 microgram/mL	200 microgram/mL	Infant weight (Guide Only)	<1 kg	1 to 3 kg	>3 kg	0.2 microgram/kg/minute	0.24 mL/kg/hour	0.12 mL/kg/hour	0.06 mL/kg/hour
Milrinone concentration	50 microgram/mL	100 microgram/mL	200 microgram/mL												
Infant weight (Guide Only)	<1 kg	1 to 3 kg	>3 kg												
0.2 microgram/kg/minute	0.24 mL/kg/hour	0.12 mL/kg/hour	0.06 mL/kg/hour												

20 mL Syringe

Draw up milrinone and add compatible fluid* as per table below to make a final volume of 20 mL

Milrinone concentration	50 microgram/mL	100 microgram/mL	200 microgram/mL
Volume of milrinone (1 mg/mL)	1 mL (1000 microgram)	2 mL (2000 microgram)	4 mL (4000 microgram)
Volume of compatible fluid*	19 mL	18 mL	16 mL
Total volume	20 mL	20 mL	20 mL

*Compatible fluid: glucose 5% or sodium chloride 0.9%

50 mL Syringe

Draw up milrinone and add compatible fluid* as per table below to make a final volume of 50 mL

Milrinone concentration	50 microgram/mL	100 microgram/mL	200 microgram/mL
Volume of milrinone (1 mg/mL)	2.5 mL (2500 microgram)	5 mL (5000 microgram)	10 mL (10,000 microgram)
Volume of compatible fluid*	47.5 mL	45 mL	40 mL
Total volume	50 mL	50 mL	50 mL

*Compatible fluid: glucose 5% or sodium chloride 0.9%

For preterm infants – if loading dose is not given, titrate the maximal infusion rate to 0.5 microgram/kg/minute if required. Avoid prolonged infusion > 0.2 microgram/kg/minute in very preterm infants.

Administration	Continuous IV infusion preferably via central line. Change solution every 24 hours. Adjust infusion rate based on haemodynamic and clinical response. Loading dose: IV infusion over ONE hour
Monitoring	Heart rate, ECG and blood pressure Urine output and peripheral perfusion frequently. Fluid and electrolytes. Liver function. Platelets
Contraindications	Severe obstructive aortic or pulmonary valvular disease or hypertrophic subaortic stenosis. Hypersensitivity to milrinone, other 3,4'-bipyridines (inamrinone) or any other ingredient of the formulation.
Precautions	Ensure adequate circulating blood volume prior to commencement. Loading dose: Considered optional depending on clinical circumstances. May cause hypotension. Monitor BP and heart rate closely and ensure adequate volume replacement. Prematurity: Long half-life reported (10 hours) in very preterm infants. ⁵ Avoid prolonged higher rate infusion ≥0.2 microgram/kg/minute. Renal impairment: Significantly increases half-life of milrinone. A reduction in the infusion rate in patients with renal impairment to prevent drug accumulation is advised. Patient recovery: Improvement in cardiac output with resultant diuresis may necessitate a reduction in the dose of diuretic. Potassium loss due to excessive diuresis may predispose digitalised patients to arrhythmias.
Drug interactions	None known
Adverse reactions	Ventricular arrhythmias in cardiac patients. Patent ductus arteriosus. May cause hypotension.
Compatibility	Fluids: Glucose 5%, sodium chloride 0.9%. PN at Y site: Amino acid-glucose-trace element mixture. Lipid at Y site: SMOF lipid Y-site: Aciclovir, adrenaline (epinephrine) hydrochloride, amikacin, amiodARone, amphotericin B liposome, ampicillin, anidulafungin, atenolol, atracurium, aziTHROMYCIN, aztreonam, bivalirudin, caffeine citrate, calcium chloride, calcium gluconate, caspofungin, cefaZOLin, cefEPIME, cefiderocol,

	cefOTAXIME, cefotetan, cefOXITIN, ceftAZIDIME, ceftizoxime, ceFTRIAXONE, cefuroxime, ciPROFLOXAcin, cisatracurium, clindamycin phosphate, cloxacillin, dexAMETHASOne sodium phosphate, dexMEDETOMIDine, digoxin, dobutamine, dopamine, doripenem, doxycycline, enalaprilat, epinephrine, erythromycin lactobionate, fentanyl, flucONAZOLe, ganciclovir, gentamicin sulfate, glyceryl trinitrate, glycopyrrolate, heparin, hydrALAZINe, hydrocortisone sodium succinate, insulin (short-acting), ketamine, labetalol, linEZOLID, LORazepam, magnesium sulfate, meropenem, methadone, methylprednisolone sodium succinate, metoprolol, metronidazole, midazolam, morphine sulfate, naloxone, nicardipine, nitroglycerin, noradrenaline (norepinephrine), octreotide, pamidronate, pancuronium, pentobarbital, phenobarbital, piperacillin/tazobactam, potassium acetate, potassium chloride, propofol, propranolol, ranitidine, remifentanyl, rocuronium, sildenafil, sodium acetate, sodium bicarbonate, sodium nitroprusside, succinylcholine, sulfamethoxazole/trimethoprim, TACrolimus, ticarcillin, ticarcillin/clavulanate, tobramycin, vancomycin, vasopressin, vecuronium, verapamil, voriconazole, zidovudine.
Incompatibility	Fluids: No information. Y-site: Alprostadil, amphotericin B, amphotericin B lipid complex, esmolol, furosemide (frusemide), lidocaine, ondansetron, pantoprazole, phenytoin.
Stability	Milrinone GH: If storage is necessary, diluted solution may be stored at 2-8°C and use within 24 hours. Milrinone-Baxter: Diluted solution should be used immediately or as soon as practical to reduce microbiological hazard.
Storage	Milrinone Baxter: Store below 30°C. Do not freeze. Milrinone GH: Store below 25°C. Do not freeze. Protect from light.
Excipients	Milrinone GH, Milrinone-Baxter: Glucose (monohydrate or anhydrous), lactic acid or sodium hydroxide (for pH adjustment), and water for injections.
Special comments	Discard mixtures exhibiting colour change
Evidence	<p>Efficacy</p> <p>Treatment of pulmonary hypertension in near term infants: Case series report improvements in pulmonary and systemic haemodynamics and oxygenation in infants with pulmonary hypertension treated with nitric oxide.^{1, 6, 7} (LOE IV GOR C)</p> <p>Treatment of very pre-term infants: An RCT found no difference in measures of systemic blood flow when used preventatively in extremely premature infants.⁸ Case series reported improvement in oxygenation and a fall in blood pressure in pre-term infants with pulmonary hypertension treated with nitric oxide.⁹ There are insufficient data to determine the efficacy and safety of milrinone in pre-term infants with pulmonary hypertension and/or myocardial dysfunction.¹⁰ (LOE II⁸, GOR C)</p> <p>Neonates and infants undergoing cardiac surgery: A single RCT found high dose milrinone reduced the risk of LCOS post cardiac surgery.^{2, 3} (LOE II, GOR B) An historical control study reported use of milrinone post ductal ligation improved ventilation and reduced inotrope use.¹¹ (LOE IV, GOR C)</p> <p>Infants and children with shock associated with myocardial dysfunction: An RCT found milrinone 0.5 microgram/kg/min reduced mortality in children with enterovirus 71-induced pulmonary oedema and/or shock. A loading dose was not used.⁴ (LOE II, GOR B)</p> <p>Safety</p> <p>Reports of arrhythmias, tachycardia, hypotension and hypokalaemia, bronchospasm, headaches, thrombocytopenia, anaemia and elevated serum liver enzymes. In neonates treated with milrinone, hypotension and intraventricular haemorrhage have been observed.^{2, 6} (LOE IV)</p> <p>Pharmacokinetics</p> <p>Extremely pre-term infants for prevention of low systemic blood flow: T_½ averaged 10 hours. Milrinone loading infusion 0.75 microgram/kg/min for 3 hours followed by maintenance infusion 0.2 microgram/kg/min achieved target concentrations of 180–300 nanogram/mL.⁵ (LOE IV GOR C)</p> <p>Term infants with pulmonary hypertension: Half-life (t_½) averaged 4 hours. Loading dose 50 microgram/kg resulted in sub-therapeutic concentrations. Maintenance infusion 0.33–0.99 microgram/kg/min resulted in concentrations above target range (180–300 nanogram/mL).¹ (LOE IV GOR C)</p> <p>Term newborns with hypoplastic left heart undergoing surgery: Neonates received an initial dose of either a 100 or 250 microgram/kg of milrinone into the cardiopulmonary bypass circuit. A constant infusion of 0.5 microgram/kg/min resulted in drug accumulation during the initial 12 h of drug administration. Postoperatively, milrinone clearance was significantly impaired. Initial loading dose of</p>

	<p>100 microgram/kg on cardiopulmonary bypass resulted in plasma concentrations similar to those observed in other therapeutic settings. In the postoperative setting of markedly impaired renal function, an infusion rate of 0.2 microgram/kg/min should be considered.¹²</p> <p>Paediatric patients with septic shock: T_½ averaged 1.47 hours (range, 0.62 to 10.85 hours). Loading dose 75 microgram/kg and starting infusion rates 0.75–1.0 microgram/kg/min for patients with normal renal function recommended.¹³</p> <p>Prevention of low cardiac output syndrome post cardiac surgery in infants: Loading dose 50 microgram/kg then infusion 3 microgram/kg/min for 30 minutes and then a maintenance infusion 0.5 microgram/kg/min, with adjustment for age.¹⁴ (LOE IV GOR C).</p>
References	<ol style="list-style-type: none"> McNamara PJ, Shivananda SP, Sahni M, Freeman D, Taddio A. Pharmacology of milrinone in neonates with persistent pulmonary hypertension of the newborn and suboptimal response to inhaled nitric oxide. <i>Pediatric critical care medicine : a journal of the Society of Critical Care Medicine and the World Federation of Pediatric Intensive and Critical Care Societies</i>. 2013;14:74-84. Burkhardt BE, Rucker G, Stiller B. Prophylactic milrinone for the prevention of low cardiac output syndrome and mortality in children undergoing surgery for congenital heart disease. <i>The Cochrane database of systematic reviews</i>. 2015;3:CD009515. Hoffman TM, Wernovsky G, Atz AM, Kulik TJ, Nelson DP, Chang AC, Bailey JM, Akbary A, Kocsis JF, Kaczmarek R, Spray TL, Wessel DL. Efficacy and safety of milrinone in preventing low cardiac output syndrome in infants and children after corrective surgery for congenital heart disease. <i>Circulation</i>. 2003;107:996-1002. Chi CY, Khanh TH, Thoa le PK, Tseng FC, Wang SM, Thinh le Q, Lin CC, Wu HC, Wang JR, Hung NT, Thuong TC, Chang CM, Su IJ, Liu CC. Milrinone therapy for enterovirus 71-induced pulmonary edema and/or neurogenic shock in children: a randomized controlled trial. <i>Critical care medicine</i>. 2013;41:1754-60. Paradisi M, Jiang X, McLachlan AJ, Evans N, Kluckow M, Osborn D. Population pharmacokinetics and dosing regimen design of milrinone in preterm infants. <i>Archives of disease in childhood Fetal and neonatal edition</i>. 2007;92:F204-9. James AT, Corcoran JD, McNamara PJ, Franklin O, El-Khuffash AF. The effect of milrinone on right and left ventricular function when used as a rescue therapy for term infants with pulmonary hypertension. <i>Cardiology in the young</i>. 2015:1-10. McNamara PJ, Laique F, Muang-In S, Whyte HE. Milrinone improves oxygenation in neonates with severe persistent pulmonary hypertension of the newborn. <i>Journal of critical care</i>. 2006;21:217-22. Paradisi M, Evans N, Kluckow M, Osborn D. Randomized trial of milrinone versus placebo for prevention of low systemic blood flow in very preterm infants. <i>The Journal of pediatrics</i>. 2009;154:189-95. James AT, Bee C, Corcoran JD, McNamara PJ, Franklin O, El-Khuffash AF. Treatment of premature infants with pulmonary hypertension and right ventricular dysfunction with milrinone: a case series. <i>Journal of perinatology : official journal of the California Perinatal Association</i>. 2015;35:268-73. Bassler D, Kreutzer K, McNamara P, Kirpalani H. Milrinone for persistent pulmonary hypertension of the newborn. <i>The Cochrane database of systematic reviews</i>. 2010:CD007802. Jain A, Sahni M, El-Khuffash A, Khadawardi E, Sehgal A, McNamara PJ. Use of targeted neonatal echocardiography to prevent postoperative cardiorespiratory instability after patent ductus arteriosus ligation. <i>The Journal of pediatrics</i>. 2012;160:584-9 e1. Zuppa AF, Nicolson SC, Adamson PC, Wernovsky G, Mondick JT, Burnham N, Hoffman TM, Gaynor JW, Davis LA, Greeley WJ, Spray TL, Barrett JS. Population pharmacokinetics of milrinone in neonates with hypoplastic left heart syndrome undergoing stage I reconstruction. <i>Anesthesia and analgesia</i>. 2006;102:1062-9. Lindsay CA, Barton P, Lawless S, Kitchen L, Zorka A, Garcia J, Kouatli A, Giroir B. Pharmacokinetics and pharmacodynamics of milrinone lactate in pediatric patients with septic shock. <i>The Journal of pediatrics</i>. 1998;132:329-34. Bailey JM, Miller BE, Lu W, Tosone SR, Kanter KR, Tam VK. The pharmacokinetics of milrinone in pediatric patients after cardiac surgery. <i>Anesthesiology</i>. 1999;90:1012-8. 15. Australian Product Information Milrinone-Baxter (Milrinone lactate). Available from https://www.ebs.tga.gov.au/ebs/picmi/picmirepository.nsf/pdf?OpenAgent=&id=CP-2018-PI-02535-1&d=20260217172310101. Accessed 17/02/2026.

16. Merative™ Micromedex® Complete IV Compatibility (electronic version). Merative, Ann Arbor, Michigan, USA. Available at: <https://www.micromedexsolutions.com/> (cited: Feb/17/2026).

Appendix

Infusion tables to assist with concentration selection

Table 1: Infusion rates when using milrinone concentration **50 microgram/mL**

Rate (mL/hr)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Weight (kg)	Approximate microgram/kg/minute									
0.5	0.17	0.33	0.5	0.67	0.83	1	1.17	1.33	1.5	1.67
1	0.08	0.17	0.25	0.33	0.42	0.5	0.58	0.67	0.75	0.83
1.5	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.44	0.5	0.56
2	0.04	0.08	0.13	0.17	0.21	0.25	0.29	0.33	0.38	0.42
2.5	0.03	0.07	0.10	0.13	0.17	0.2	0.23	0.27	0.3	0.33
3	0.03	0.06	0.08	0.11	0.14	0.17	0.19	0.22	0.25	0.28
3.5	0.02	0.05	0.07	0.1	0.12	0.14	0.17	0.19	0.21	0.24
4	0.02	0.04	0.06	0.08	0.1	0.13	0.15	0.17	0.19	0.21
4.5	0.02	0.04	0.06	0.07	0.09	0.11	0.13	0.15	0.17	0.19
5	0.02	0.03	0.05	0.07	0.08	0.10	0.12	0.13	0.15	0.17

Table 2: Infusion rates when using milrinone concentration **100 microgram/mL**

Rate (mL/hr)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Weight (kg)	Approximate microgram/kg/minute									
0.5	0.33	0.67	1	1.33	1.67	2	2.33	2.67	3	3.33
1	0.17	0.33	0.5	0.67	0.83	1	1.17	1.33	1.5	1.67
1.5	0.11	0.22	0.33	0.44	0.56	0.67	0.78	0.89	1	1.11
2	0.08	0.17	0.25	0.33	0.42	0.5	0.58	0.67	0.75	0.83
2.5	0.07	0.13	0.2	0.27	0.33	0.4	0.47	0.53	0.6	0.67
3	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.44	0.5	0.56
3.5	0.05	0.10	0.14	0.19	0.24	0.29	0.33	0.38	0.43	0.48
4	0.04	0.08	0.13	0.17	0.21	0.25	0.29	0.33	0.38	0.42
4.5	0.04	0.07	0.11	0.15	0.19	0.22	0.26	0.3	0.33	0.37
5	0.03	0.07	0.10	0.13	0.17	0.2	0.23	0.27	0.3	0.33

Table 3: Infusion rates when using milrinone concentration **200 microgram/mL**

Rate (mL/hr)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Weight (kg)	Approximate microgram/kg/minute									
0.5	0.67	1.33	2	2.67	3.33	4	4.67	5.33	6	6.67
1	0.33	0.67	1	1.33	1.67	2	2.33	2.67	3	3.33
1.5	0.22	0.44	0.67	0.89	1.11	1.33	1.56	1.78	2	2.22
2	0.17	0.33	0.5	0.67	0.83	1	1.17	1.33	1.5	1.67
2.5	0.13	0.27	0.4	0.53	0.67	0.8	0.93	1.07	1.2	1.33
3	0.11	0.22	0.33	0.44	0.56	0.67	0.78	0.89	1	1.11
3.5	0.1	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.95
4	0.08	0.17	0.25	0.33	0.42	0.5	0.58	0.67	0.75	0.83
4.5	0.07	0.15	0.22	0.3	0.37	0.44	0.52	0.59	0.67	0.74
5	0.07	0.13	0.2	0.27	0.33	0.4	0.47	0.53	0.60	0.67

	$\text{Rate (mL/hr)} = \frac{60 \times \text{Dose (microgram/kg/min)} \times \text{Weight (kg)}}{\text{Concentration (microgram/mL)}}$
	$\text{Dose (microgram/kg/min)} = \frac{\text{Rate (mL/hr)} \times \text{Concentration (microgram/mL)}}{\text{Weight (kg)} \times 60}$

VERSION/NUMBER	DATE
Original 1.0	22/08/2025
Version 1.0 (minor errata)	26/09/2025
Version 1.0 (minor errata)	5/10/2025
Version 1.0 (minor errata)	19/02/2026
Current 1.1	08/10/2026
REVIEW	08/10/2031

This standard concentration formulary has been developed by the ANMF standard concentration working group. The working group (in alphabetical order): Celia Cunha da Silva, Cindy Chen, Dianne Lee, Gloria Yoo, Kerrie Knox, Michelle Jenkins, Mohammad Irfan Azeem, Rebecca O'Grady, Simarjit Kaur and Susanah Brew.

Authors Contribution

Original author/s	David Osborn, Srinivas Bolisetty
Evidence Review of the original	David Osborn
Expert review of the original	Hari Ravindranathan
Nursing Review of the original	Eszter Jozsa, Kirsty Minter
Pharmacy Review	Kerrie Knox, Rebecca O'Grady, Mohammad Irfan Azeem, Michelle Jenkins
ANMF Group contributors	Nilkant Phad, Bhavesh Mehta, Amber Seigel, Rebecca Barzegar, Jutta van den Boom, Mohammed Irfan Azeem, Michelle Jenkins, Kerrie Knox, Cindy Chen, Benjamin Emerson-Parker, Renae Gengaroli, Dianne Lee, Gloria Yoo, Bryony Malloy, Celia Cunha da Silva, Simarjit Kaur, Thao Tran
Final editing	Srinivas Bolisetty, Celia Cunha da Silva
Electronic version	Ian Callander
Facilitator	Srinivas Bolisetty

Citation for the current version

Australasian Neonatal Medicines Formulary (ANMF). Milrinone - Standard concentration. Version number: 1.1. Date of publication 8/10/2026. <https://www.anmfonline.org/>