Glucagon – Standard Concentration

Newborn use only

2025

Indication	Management of neonatal hypoglycaemia: • Refractory to intravenous glucose infusions • When glucose infusion is unavailable Management of hyperinsulinaemic hypoglycaemia (e.g. congenital hyperinsulinism). Adjunctive treatment of beta-blocker overdose.
Action	Stimulates hepatic gluconeogenesis and glycogenolysis. Glucagon has a positive inotropic action.
Drug type	Polypeptide hormone – hyperglycaemic agent
Trade name	GlucaGen HypoKit 1 mg/mL
Presentation	1 mg/mL vial. 1 unit of glucagon = 1 mg (1000 microgram) glucagon
Dose	**IV bolus/IM/SC** 200 microgram/kg/dose. Do not exceed 1 mg/dose. IV glucose is to be administered as soon as possible. **IV infusion** 5–20 microgram/kg/hour. Consider starting dose of 20 microgram/kg/hour and decrease carefully, monitoring blood glucose, until the minimum effective dose is reached. **Beta-blocker overdose:** Refer to evidence summary.
Dose adjustment	Therapeutic hypothermia – No information. ECMO – NO information. Renal impairment – No information. Hepatic impairment – No information.
Maximum dose	Maximum stat dose: 1 mg (1000 microgram)
Route	IV, IM, SC
Preparation	**IV bolus/IM/SC:** Reconstitute 1 mg (1000 microgram) glucagon vial with 1 mL of diluent provided (water for injection) to make a 1 mg/mL (1000 microgram/mL) solution. **IV infusion**: **Note: Refer to Appendix for tables to assist with concentration selection.** 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 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.** For patients weighing less than 0.4kg, further dilution may be required. 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

Glucagon concentration	40 microgram/mL	80 microgram/mL	160 microgram/mL
Infant weight (Guide Only)	<1kg	1 to 3kg	>3kg
10 microgram/kg/hour is equal to	0.25 mL/kg/hour	0.125 mL/kg/hour	0.0625 mL/kg/hour

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20mL Syringe

Reconstitution: Add 1 mL of diluent provided (water for injection) to the 1 mg vial (1000 microgram) of glucagon to make **a 1mg/mL (1000 microgram/mL) solution.**

It is a 2-step dilution for the 40 microgram/mL solution only. It is a 1-step dilution for the 80 and 160 microgram/mL concentrations.

Step 1: Draw up glucagon reconstitution and add compatible fluid* to make a diluted solution as per table below:

Glucagon concentration	40 microgram/mL	80 microgram/mL	160 microgram/mL
Volume of glucagon reconstitution (1 mg/mL)	1 mL (1 mg)	1.6 mL (1.6 mg)	3.2 mL (3.2 mg)
Volume of compatible fluid*	4 mL	18.4 mL	16.8 mL
Total volume	5 mL **(200 microgram/mL)**	20 mL	20 mL

Step 2: Draw up diluted glucagon and add compatible fluid* as per table below to make a final volume of 20 mL

Glucagon concentration	40 microgram/mL
Volume of diluted glucagon from step 1	4 mL (800 microgram)
Volume of compatible fluid*	16 mL
Total volume	20 mL

* Compatible fluid: glucose 5%

50mL Syringe

Reconstitution: Add 1 mL of diluent provided (water for injection) to the 1 mg vial (1000 microgram) of glucagon to make **a 1 mg/mL (1000 microgram/mL) solution.**

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

Glucagon concentration	40 microgram/mL	80 microgram/mL	160 microgram/mL
Volume of glucagon (1 mg/mL)	2 mL (2 mg)	4 mL (4 mg)	8 mL (8 mg)
Volume of compatible fluid*	48 mL	46 mL	42 mL
Total volume	50 mL	50 mL	50 mL

* Compatible fluid: glucose 5%

Administration	Do not use the reconstituted solution unless it is clear. **IV bolus**: Administer 0.2 mL/kg of the reconstituted solution (to a maximum 1 mL) over 3 to 5 minutes. **IM:** Inject into the anterolateral thigh (preferred) or the ventrogluteal areas.[1,2]. **SC:** Inject into the area over the deltoid muscle or over the anterolateral thigh.[1,3] **Continuous IV infusion:** Via syringe driver.
Monitoring	Blood glucose concentrations, watch for rebound hypoglycaemia after cessation. Consider cardiorespiratory and blood pressure monitoring. Electrolytes for continuous infusion.
Contraindications	Phaeochromocytoma[4-6], glucagonoma. Hypersensitivity to glucagon or any component.
Precautions	Hypertension. Insulinoma: Glucagon has been used to treat hypoglycaemia caused by insulinoma. However, it should be used cautiously because of the propensity to release insulin.[7]
Drug interactions	Drug interactions largely unreported in newborn infants. Glucagon has a positive inotropic action which may counteract effect of beta-blockers. Beta-blockers may reduce hyperglycaemic effect of glucagon.[8]

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	Warfarin: Increased effect of warfarin resulting in increased risk of bleeding.[9] Indomethacin: Glucagon may lose its ability to raise blood glucose or paradoxically may even produce hypoglycaemia.[7]
Overdose	AUSTRALIA: Contact the Poisons Information Centre on **13 11 26** for management NEW ZEALAND: Contact the National Poisons Centre on **0800 764 766** for management
Adverse reactions	Generally well tolerated. Transient increase in blood pressure and pulse rate.[7] Anaphylaxis or hypersensitivity reactions have been reported in adults.[7] Very rare: Hypertension, hypotension, vomiting.[7] Erythema necrolyticum migrans (erythematosquamous skin lesions) has been reported with prolonged glucagon infusion.
Compatibility	**Fluids:** Glucose 5%.[21] **PN at Y-site:** No information **Y-site:** naloxone.
Incompatibility	**Fluids:** Solutions that contain calcium. **PN at Y-site:** No information **Y-site:** No information.
Stability	Discard any unused solution. Continuous IV infusion should be used within 24 hours
Storage	Store below 25°C. Do not freeze. The sealed container should be protected from light.
Excipients	Lactose monohydrate, hydrochloric acid (for pH adjustment), sodium hydroxide (for pH adjustment), and water for injections.
Evidence	**Efficacy** **Treatment of hypoglycaemia:** The data are mainly derived from case series and case reports.[10-13] A single bolus dose of glucagon (200 microgram/kg) caused a rapid rise in hepatic glucose production rate in newborns with hypoglycaemia.[12] (LOE IV) Glucagon infusion (0.5–1 mg/day = 20–40 microgram/hour) resulted in a significant rise in blood glucose concentration within 4 hours of infusion in newborn infants irrespective of the cause of hypoglycaemia.[13] (LOE IV, GOR C). Glucose production in response to a glucagon 100 microgram/kg bolus was comparable in preterm, Appropriately Grown for Age and Small for Gestational Age infants.[14] (LOE IV). Glucagon infusion (20–40 microgram/hour) has been used to treat refractory hypoglycaemia in sick preterm infants (mean birth weight 1814 g and gestational age 32 weeks).[11] (LOE IV) **Treatment of low-output heart failure associated with beta-blocker overdose:** A case report of a preterm infant with low output heart failure after maternal labetalol use who responded to repeated use of intravenous glucagon 0.3 to 0.6 mg/kg.[15] (LOE IV GOR C). This is consistent with doses in case reports of glucagon use for adult beta-blocker overdose.[16] **Safety** Hyponatraemia has been variably reported with glucagon infusion[13,17,18] although it may be explained by other factors including glucose infusion. (LOE IV GOR D) Thrombocytopenia has been reported[13,17] although a case series found increasing platelet counts during infusion.[11] Erythema necrolyticum migrans (erythematosquamous skin lesions) has been reported with prolonged glucagon infusion.[19,20] Glucagon has been reported to induce hypertension in patients with phaeochromocytoma.[8,10,11] Adverse cardiovascular events attributable to glucagon have not been reported in newborns. **Pharmacodynamics** An effect on blood glucose is usually seen within 5–20 minutes after IV, IM or SC administration.[11] Response to an intravenous bolus persists for at least 45 minutes.[13] **Pharmacokinetics** Adult data report half-life of 8–18 minutes.[7]
References	1. Australian Technical Advisory Group on Immunisation (ATAGI). Australian Immunisation Handbook, Australian Government Department of Health and Aged Care, Canberra, 2022, immunisationhandbook.health.gov.au. Accessed on 27/11/2025. 2. Rishovd A. Pediatric intramuscular injections: guidelines for best practice. MCN Am J Matern Child Nurs. 2014;39:107-12; quiz 13-4. 3. Hensel D, Morson GL, Preuss EA. Best practices in newborn injections. MCN Am J Matern Child Nurs. 2013;38:163-7; quiz 8-9. 4. Hosseinnezhad A, Black RM, Aeddula NR, Adhikari D, Trivedi N. Glucagon-induced pheochromocytoma crisis. Endocr Pract. 2011;17:e51-4.

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5. Minamori Y, Yammoto M, Tanaka A, Takeda N, Yasuda K. Hazard of glucagon test in diabetic patients. Hypertensive crisis in asymptomatic pheochromocytoma. Diabetes Care. 1992;15:1437-8.
6. Sebel EF, Hull RD, Kleerekoper M, Stokes GS. Responses to glucagon in hypertensive patients with and without pheochromocytoma. Am J Med Sci. 1974;267:337-43.
7. Product Information: GlucaGen(R) intramuscular injection, intravenous injection, subcutaneous injection, glucagon rDNA origin intramuscular injection, intravenous injection, subcutaneous injection. Boehringer Ingelheim Pharmaceuticals, Inc. (per DailyMed), Ridgefield, CT, 2014.
8. Messerli FH, Kuchel O, Tolis G, Hamet P, Fraysse J, Genest J. Effects of beta-adrenergic blockade on plasma cyclic AMP and blood sugar responses to glucagon and isoproterenol in man. Int J Clin Pharmacol Biopharm. 1976;14:189-94.
9. MerativeTM Micromedex® Complete IV Compatibility (electronic version). Merative, Ann Arbor, Michigan, USA. Available at: https://www.micromedexsolutions.com/ (cited: Feb/26/2026).
10. Carter PE, Lloyd DJ, Duffty P. Glucagon for hypoglycaemia in infants small for gestational age. Arch Dis Child. 1988;63:1264-6.
11. Charsha DS, McKinley PS, Whitfield JM. Glucagon infusion for treatment of hypoglycemia: efficacy and safety in sick, preterm infants. Pediatrics. 2003;111:220-1.
12. Hawdon JM, Aynsley-Green A, Ward Platt MP. Neonatal blood glucose concentrations: metabolic effects of intravenous glucagon and intragastric medium chain triglyceride. Arch Dis Child. 1993;68:255-61.
13. Miralles RE, Lodha A, Perlman M, Moore AM. Experience with intravenous glucagon infusions as a treatment for resistant neonatal hypoglycemia. Archives of Pediatrics & Adolescent Medicine. 2002;156:999-1004.
14. van Kempen AA, Ackermans MT, Endert E, Kok JH, Sauerwein HP. Glucose production in response to glucagon is comparable in preterm AGA and SGA infants. Clin Nutr. 2005;24:727-36.
15. Stevens TP, Guillet R. Use of glucagon to treat neonatal low-output congestive heart failure after maternal labetalol therapy. J Pediatr. 1995;127:151-3.
16. Boyd R, Ghosh A. Towards evidence based emergency medicine: best BETs from the Manchester Royal Infirmary. Glucagon for the treatment of symptomatic beta blocker overdose. Emerg Med J. 2003;20:266-7.
17. Belik J, Musey J, Trussell RA. Continuous infusion of glucagon induces severe hyponatremia and thrombocytopenia in a premature neonate. Pediatrics. 2001;107:595-7.
18. Coulthard MG, Hey EN. Glucagon is very unlikely to have caused hyponatremia. Pediatrics. 2002;109:985.
19. Mohnike K, Blankenstein O, Pfuetzner A, Potzsch S, Schober E, Steiner S, Hardy OT, Grimberg A, van Waarde WM. Long-term non-surgical therapy of severe persistent congenital hyperinsulinism with glucagon. Horm Res. 2008;70:59-64.
20. Wald M, Lawrenz K, Luckner D, Seimann R, Mohnike K, Schober E. Glucagon therapy as a possible cause of erythema necrolyticum migrans in two neonates with persistent hyperinsulinaemic hypoglycaemia. Eur J Pediatr. 2002;161:600-3.
21. BNF for Children. Accessed on 27/11/2025.

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Appendix

Infusion tables to assist concentration selection

Table 1: Infusion rates when using glucagon concentration **40 microgram/mL**
(suggested for weight <1kg)

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 micrograms/kg/hour**									
0.5	8	16	24	32	40	48	56	64	72	80
1	4	8	12	16	20	24	28	32	36	40
1.5	2.7	5.3	8	11	13	16	18	21	24	27
2	2	4	6	8	10	12	14	16	18	20
2.5	1.6	3.2	4.8	6.4	8	9.6	11	13	14	16
3	1.3	2.7	4	5.3	6.7	8	9.3	11	12	13
3.5	1.1	2.3	3.4	4.6	5.7	6.9	8	9.1	10	11
4	1	2	3	4	5	6	7	8	9	10
4.5	0.9	1.8	2.7	3.6	4.4	5.3	6.2	7.1	8	8.9
5	0.8	1.6	2.4	3.2	4	4.8	5.6	6.4	7.2	8

Table 2: Infusion rates when using glucagon concentration **80 microgram/mL**
(suggested for weight 1 to 3kg)

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 micrograms/kg/hour**									
0.5	16	32	48	64	80	96	112	128	144	160
1	8	16	24	32	40	48	56	64	72	80
1.5	5.3	11	16	21	27	32	37	43	48	53
2	4	8	12	16	20	24	28	32	36	40
2.5	3.2	6.4	9.6	13	16	19	22	26	29	32
3	2.7	5.3	8	11	13	16	19	21	24	27
3.5	2.3	4.6	6.9	9.1	11	14	16	18	21	23
4	2	4	6	8	10	12	14	16	18	20
4.5	1.8	3.6	5.3	7.1	8.9	11	12	14	16	18
5	1.6	3.2	4.8	6.4	8	10	11	13	14	16

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Table 3: Infusion rates when using glucagon concentration **160 microgram/mL**
(suggested for weight >3kg)

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 micrograms/kg/hour**									
0.5	32	64	96	128	160	192	224	256	288	320
1	16	32	48	64	80	96	112	128	144	160
1.5	11	21.3	32	43	53	64	75	85	96	107
2	8	16	24	32	40	48	56	64	72	80
2.5	6.4	13	19	26	32	38	45	51	58	64
3	5.3	11	16	21	27	32	37	43	48	53
3.5	4.6	9.1	14	18	23	27	32	37	41	46
4	4	8	12	16	20	24	28	32	36	40
4.5	3.6	7.1	11	14	18	21	25	28	32	36
5	3.2	6.4	9.6	13	16	19	22	26	29	32

$$\text{Rate (mL/hr)} = \frac{\text{Dose (microgram/kg/hour) x Weight (kg)}}{\text{Concentration (microgram/mL)}}$$

$$\text{Dose (microgram/kg/hour)} = \frac{\text{Rate (mL/hr) x Concentration (microgram/mL)}}{\text{Weight (kg)}}$$

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