GUIDELINE

INSULIN: ADULT VARIABLE RATE INTRAVENOUS

Disclaimer: This document does not override decision based on clinical judgement and experience of the prescriber.

SCOPE

Site	Service/Department/Unit	Disciplines
Sir Charles Gairdner Hospital	All areas	Medical, Nursing, Allied Health

HIGH RISK MEDICINE

All management must be recorded in Adult Variable Rate Intravenous Insulin Management Record (MR 826), see appendix 3. This document is designed to allow both prescriptions and relevant observations to be recorded together

INTRODUCTION [1,2,3,4]

Insulin is a naturally produced hormone secreted by the pancreas. Insulin is required by the cells of the body in order for them to remove and utilise glucose from the blood. Insulin causes cells in the liver, muscle and fat tissues to absorb glucose and convert it to glycogen that can be stored. Additionally, insulin prevents the use of fat as an energy source. Administration of insulin results in lower blood glucose levels (BGLs).

Insulin is required for mandatory background (basal) and post prandial (bolus) blood glucose level (BGL) control. Insulin is considered a high risk medication as errors in therapy can result in serious harm and can be fatal. Actrapid® (insulin human neutral) is a short acting insulin preparation; typical onset of action is within 30 minutes, peak effect after 2 to 3 hours and total duration of action of 6 to 8 hours.

Fasting before surgery or diagnostic procedures can be a problem in people on insulin or oral hypoglycaemic agents. Most patients with Type 1 or Type 2 diabetes admitted to hospital can be treated with subcutaneous insulin. In some circumstances, medical practitioners may decide to use intravenous insulin therapy as an alternative.

PRESENTATION [3,5]

- Actrapid ® (Insulin Human Neutral) 100 unit/mL, 10mL vial

INDICATIONS [1,2]

1. Type 1 and unstable Type 2 insulin deficient patients with diabetes mellitus while fasting or unable to tolerate oral diet and fluids i.e Nil by mouth (NBM)
2. Unstable Type 2 patients with diabetes who are fasting or unable to tolerate oral medication and diet **without** evidence of Diabetic Ketoacidosis (DKA) or Hyperosmolar hyperglycaemia state (HHS)
3. **Follow-on (late)** management of patients with DKA or HHS who are not yet eating and drinking normally

OUT OF SCOPE: This guideline is NOT suitable for the **initial** management of DKA and HHS

Separate guidelines are available for these indications see **MR836** for DKA, and **MR838** for HHS

Please refer to these for the acute management of each condition

CONTRAINDICATIONS [3,4]

- Hypoglycaemia – BGL (mmol/L) ≤ 3.9

PRECAUTIONS [3,4]

- Hypokalaemia – administration of insulin reduces extracellular potassium by facilitating a shift of potassium into cells
- Hypersensitivity – if a patient has a documented allergy to insulin discuss with endocrinology team for further advice
- Acute trauma or illness – insulin requirements may increase. Rate of infusion will need to be

adjusted accordingly

- Total Parental Nutrition (TPN) - TPN may contain insulin and will therefore impact on patients BGL control. Although no rate adjustment is required for concurrent IV insulin and TPN, TPN with insulin may result in lower rate requirements. Patients receiving TPN therapy do not require an intravenous glucose infusion to be co administered

DOSAGE

- Insulin and glucose for the above indications must be prescribed on the Adult Variable Rate Intravenous (IV) Insulin Management Record- MR 826
- Standard insulin dilution: 50 units of Actrapid ® (Insulin Human Neutral) in **50mL** sodium chloride 0.9%. Note: a 50mL sodium chloride 0.9% (Baxter) bag will contain a small amount of overage however should not be considered significant for use with this protocol
- Continue usual subcutaneous basal insulin in addition to IV insulin - patients established on basal insulin (e.g. Lantus ®, Levemir ®) must be prescribed their regular bolus dose with IV insulin even if fasting to avoid hyperglycaemia and ketosis. Prescribe the bolus insulin on the Insulin Subcutaneous Order and Blood Glucose Record - Adult MR846. *(See Appendix 1 for a list of basal insulin available)*

ADMINISTRATION

Glucose10% must always run concurrently with IV insulin infusion.

- EXCEPTION**:** Patients receiving TPN therapy do not require concurrent intravenous glucose infusion as TPN contains required glucose.

Unopposed insulin administration carries a high risk of severe hypoglycaemia.

Setting up the Insulin and Glucose 10% infusion

- Administration must be via infusion pump
- Insulin and Glucose 10% must be clearly labelled
- Insulin and glucose can be administered through the same intravenous cannula using one infusion pump
- Glucose 10% must run on the A line/arm whilst the insulin infusion must run on the B line/arm
- Refer to Appendix 2 for further illustration/ information

Starting Rate

- A starting rate of infusion **must be indicated by the Medical Team** and on the IV insulin chart (MR 826)
- A suggested starting rate is 4 mL/hr (4 units Actrapid ® Insulin per hour) however consideration should be made to the patient's relative daily insulin requirements or insulin resistance and a higher rate may be indicated
- For patients converting from DKA or HHS management: the infusion rate will need to be manually changed on the MR826 to the current equivalent dose administered as part of the DKA protocol
- Please contact the Endocrinology Registrar via switch board if guidance is needed

Recording management on the IV insulin chart

- Nursing staff must record the start and stop time of the insulin and glucose infusion on the Adult Intravenous Insulin Chart MR 826
- Once the prescriber has completed the prescriptions appropriately, nursing staff may adjust insulin infusion rate after BGL's as per the Insulin Infusion Nomogram located on the front of MR 826
- Two nurses are required to check rate and sign insulin protocol chart

Monitoring

- Blood glucose levels (BGL) are to be tested (ward blood glucose meter) hourly for the first 4 hours
- If the insulin infusion rate remains unchanged after this period of time decrease BGL monitoring to 2 hourly for 12 hours then consider 3 hourly monitoring if stable or as directed by the doctor
- Revert back to hourly monitoring if infusion rate changed
- Monitor BGL hourly for 2 hours after stopping the insulin infusion then as per routine monitoring protocol
- Ketones – monitor as per the NPG No.2: Diabetes Patient Management or as clinically indicated by the treating team Check U&E's 6 hours after starting the infusion and then ONCE daily thereafter
- Potassium and additional fluid requirements to be decided by the prescribing doctor. These must be reviewed on a regular basis (at least daily) and will be prescribed on a standard IV Fluid order.
- If administering >10mmol per hour of potassium chloride cardiac monitoring must be in place; refer to Administration of Intravenous Potassium Guideline
- Seek Endocrinology team advice if regimen is failing to control patient's BGLs

Ceasing IV insulin therapy

- Stopping the infusion must only be determined and ordered by the treating medical team. As a guide the infusion should only stop once the patient is tolerating oral diet and fluids **normally**
- For patients previously on **oral** hypoglycaemic (OHG) therapy:
  - Aim to stop early morning and give usual OHG's at the time of stopping
- For patients previously on subcutaneous **insulin** therapy:
  - Aim to stop with a meal and give the usual mealtime subcutaneous insulin. Insulin infusion should stop 1 hour after the subcutaneous dose was administered
  - **Note:** If no basal insulin has been given for >24 hours, aim to convert to subcutaneous insulin with evening meal and give usual basal dose *OR* convert at breakfast with half of the usual basal dose and then give remainder of the dose with the patient's evening meal
- **For patients with known diabetes on multiple daily bolus injections:**
  - Recommence usual bolus insulin with next meal
  - Cease IV insulin infusion 30 mins after bolus injection
  - *Note: if no basal insulin has been given for >24 hours aim to convert to subcut insulin with evening meal and give usual basal dose **OR** convert at breakfast with half the usual basal dose and then give remainder of dose with evening meal*
- **For patients on CSII (insulin pump) therapy:**
  - seek advice from diabetes team / Endocrinology before recommencing pump
  - Cease IV insulin infusion 30 mins after recommencing pump
- **For patients with newly diagnosed type 1 diabetes:**
  - Refer to DKA guideline or seek advice from diabetes team / Endocrinology before initiating subcutaneous therapy

PRACTICAL POINTS

Drug Interactions [3,4]

- Thiazolideinediones e.g. pioglitazone, rosiglitazone – increased risk of oedema and heart failure Concurrent use of insulin and rosiglitazone is contraindicated; use combination with pioglitazone cautiously

Adverse Effects [3,4]

- Hypoglycaemia – most frequent and serious. Symptoms include sweating, hunger, faintness, palpitations, tremor, headache, visual disturbances and/ or altered mood

Compatibility [5]

- Compatible Fluids: Glucose 5%, glucose 10%, glucose 50%, Hartmann's via Y-site, Ringer's via Y-site, sodium chloride 0.9%
- Compatible Drugs Y-Site: Amiodarone, caspofungin, ceftaroline, esmolol, ethanol, glyceryl trinitrate, milrinone, morphine sulfate, potassium chloride, sodium nitroprusside
- Incompatibility with Drugs: aminophylline, cefoxitin, dopamine, glycopyrrolate, ketamine, labetalol, micafungin, noradrenaline, pentamidine, phentolomine, phenylephrine, piperacillin-tazobactam (EDTA Free), protamine, rocuronium

Storage [3,4]

- Each prepared solution can be stored or used for up to 24 hours at room

temperature. Any remaining solution at this time should be discarded and a fresh solution prepared if the infusion is to continue
- Actrapid® vials should be stored between 2 and 8° C
- After first use, the vials may be kept at room temperature for a period of up to 4 weeks. The date of removal from refrigerated conditions must be indicated on the vial. Do not freeze
- Protect from light; when not in use vials should be protected from excessive heat and light
- The solution within the vial should appear clear and colourless; do not use if they appear uniformly white or cloudy

Pregnancy and Breastfeeding

- Pregnancy – Safe to use;
- Breastfeeding – Safe to use

ACKNOWLEDGMENTS

Fiona Stanley Hospital Adult Intravenous Insulin Infusion Chart MR 835

KEY RELATED DOCUMENTS

- Intravenous Therapy. SCGH Nursing Practice Guideline 4. Updated August 2016.
- Medication Management. SCGH Nursing Practice Guideline 51. Updated June 2018.
- Medicines Management. SCGH Hospital Policy 141. September 2017.
- Adult Diabetic Ketoacidosis (DKA) Guidelines and Management Record (MR 836),SCGH
- Adult Variable Rate Intravenous Insulin Guideline (HRM003) and Management Record (MR826)
- SCGH Adult Hyperosmolar Hyperglycaemic State Guideline and Management Record (MR 383)
- SCGH SGLT2 inhibitors (gliflozins) and euglycaemic ketoacidosis guideline (draft)

KEY LEGISLATION, ACTS & STANDARDS

- Medicines and Poisons Act 2014, Medicines and Poisons Regulations 2016, Health Services Act 2016
- MP 0077/18 Statewide Medicines Formulary January 2018
- OD 0647/16 WA National Standard for User-Applied Labelling of Injectable Medicines, Fluids and Lines, Jan 2016
- OD 0561/14 WA High Risk Medication Policy, 18th September 2014 – 31st August 2017 (current)
- Australian Commission on Safety and Quality in Healthcare. National terminology, abbreviations and symbols to be used in the prescribing and administering of medicines in Australian hospitals. 2016.

STANDARDS

- NSQHS Standard:

REFERENCES

1. eTG complete. Endocrinology 2016 Available from : https://www-tg-org-au.qelibresources.health.wa.gov.au/
2. Khan N, Ghali W, Cagilero E. Up to Date. Endocrinology and Diabetes. Perioperative management of blood glucose in adults with diabetes mellitus. February 2018. Available from https://www-uptodate-com.qelibresources.health.wa.gov.au
3. Mims Online. Full Product Information Actrapid ®. Available from: https://www-mimsonline-com-au.qelibresources.health.wa.gov.au/
4. Australian Medicine Handbook. AMH. Insulins Available from: https://amhonline-amh-net-au.qelibresources.health.wa.gov.au/
5. Australian Injectable Drug Handbook 7th Edition. Insulin-Short Acting. Available from https://aidh-hcn-com-au.qelibresources.health.wa.gov.au//

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For full details regarding review, consultation approval/endorsement - contact the DTC.

Appendix 1. List of commonly available Insulins in Australia.

Type	Brand Name	Nature
Ultra-short-acting (Peak at one hour, last 4 - 5 hours)		
Insulin lispro Insulin aspart Insulin gluisine	Humalog ® NovoRapid ® Apidra ®	Analogue Analogue Analogue
Short-acting (Peak at 2 to 5 hours, last 6 – 8 hours)		
Neutral	Acrapid ® Humilin R ® Hypurin Neutral ®	Human Human Bovine
Long acting (16-24 hours)		
Isophane	Humulin NPH ® Protaphane ® Hypurin Isophane ®	Human Human Bovine
Long acting Mixed (16-24 hours)		
Long acting mixed with ultra-short acting	Novomix 30 ® Humalog Mix 25 ® Humalog Mix 50 ®	Analogue Analogue Analogue
Long acting (Basal)		
Insulin detemir Insulin glargine Insulin glargine	Levemir ® Lantus ® * Toujeo ® *	Analogue Analogue Analogue
	* Note Lantus ® and Toujeo are not bioequivalent - seek specialist advice if converting patient.	

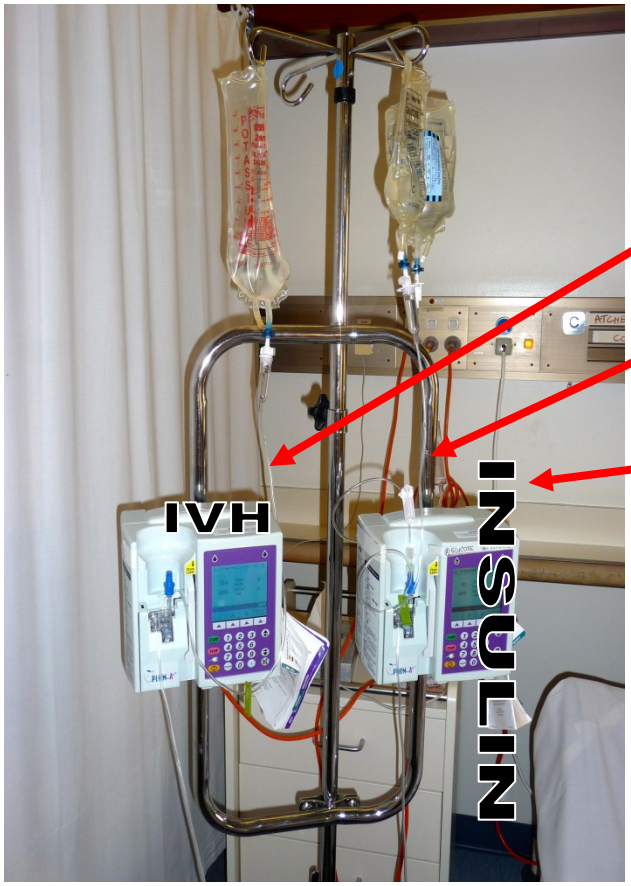
Patients established on a subcutaneous **basal insulin** dose should therefore continue this during intravenous insulin administration

Not all insulin formulations available at SCGH – Please refer to Formulary1 for local availability.

Adapted from Australian Medicine Handbook. AMH. Insulins Available from: https://amhonline-amh-net-au.qelibresources.health.wa.gov.au/

Appendix 2. Illustration: Setting up the InsulinGlucose 10% Infusion

- Ensure that each pump is marked clearly
- A Line = Glucose 10%
- B Line = Insulin
- Use the same pump – run A & B line concurrently
- Use the same cannula
- Secondary pump – for IVH (usually attached to a separate IVC)



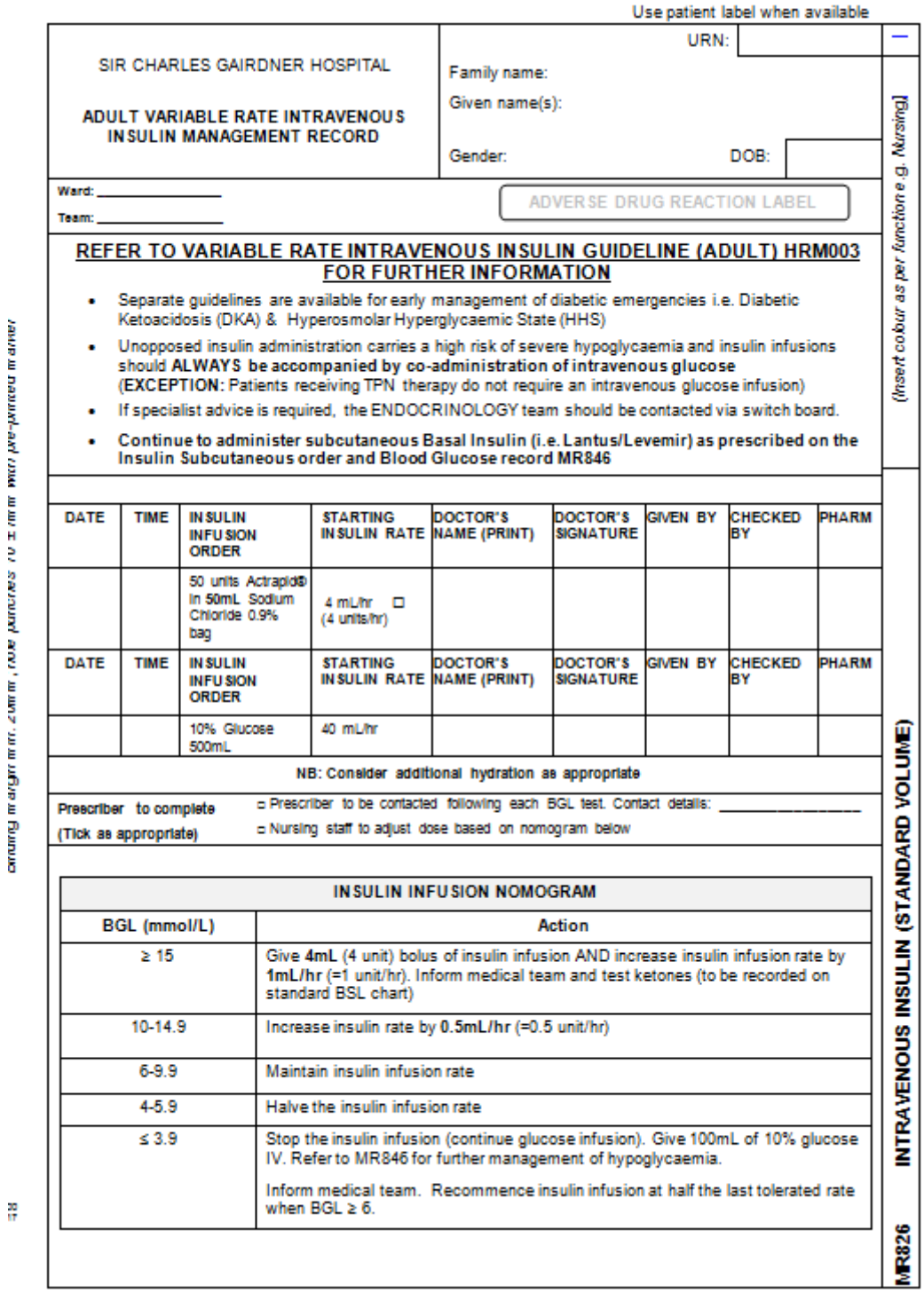
Secondary pump for IVH
(Remember Potassium replacement)

A Line = Glucose 10%

B Line = Insulin

Created by G71 Nursing staff

Appendix 3. Picture of the Adult Variable Rate Intravenous Insulin Management Record (MR 826)



Use patient label when available

SIR CHARLES GAIRDNER HOSPITAL

ADULT VARIABLE RATE INTRAVENOUS INSULIN MANAGEMENT RECORD

URN:

Family name:

Given name(s):

Gender: DOB:

Ward: _____

Team: _____

ADVERSE DRUG REACTION LABEL

(Insert colour as per function e.g. Nursing)

REFER TO VARIABLE RATE INTRAVENOUS INSULIN GUIDELINE (ADULT) HRM003 FOR FURTHER INFORMATION

- Separate guidelines are available for early management of diabetic emergencies i.e. Diabetic Ketoacidosis (DKA) & Hyperosmolar Hyperglycaemic State (HHS)
- Unopposed insulin administration carries a high risk of severe hypoglycaemia and insulin infusions should **ALWAYS be accompanied by co-administration of intravenous glucose** (**EXCEPTION:** Patients receiving TPN therapy do not require an intravenous glucose infusion)
- If specialist advice is required, the ENDOCRINOLOGY team should be contacted via switch board.
- **Continue to administer subcutaneous Basal Insulin (i.e. Lantus/Levemir) as prescribed on the Insulin Subcutaneous order and Blood Glucose record MR846**

DATE	TIME	INSULIN INFUSION ORDER	STARTING INSULIN RATE	DOCTOR'S NAME (PRINT)	DOCTOR'S SIGNATURE	GIVEN BY	CHECKED BY	PHARM
		50 units Actrapid® in 50mL Sodium Chloride 0.9% bag	4 mL/hr ☐ (4 units/hr)					
DATE	TIME	INSULIN INFUSION ORDER	STARTING INSULIN RATE	DOCTOR'S NAME (PRINT)	DOCTOR'S SIGNATURE	GIVEN BY	CHECKED BY	PHARM
		10% Glucose 500mL	40 mL/hr					

NB: Consider additional hydration as appropriate

Prescriber to complete (Tick as appropriate)

☐ Prescriber to be contacted following each BGL test. Contact details: _____

☐ Nursing staff to adjust dose based on nomogram below

INSULIN INFUSION NOMOGRAM

BGL (mmol/L)	Action
≥ 15	Give **4mL** (4 unit) bolus of insulin infusion AND increase insulin infusion rate by **1mL/hr** (=1 unit/hr). Inform medical team and test ketones (to be recorded on standard BSL chart)
10-14.9	Increase insulin rate by **0.5mL/hr** (=0.5 unit/hr)
6-9.9	Maintain insulin infusion rate
4-5.9	Halve the insulin infusion rate
≤ 3.9	Stop the insulin infusion (continue glucose infusion). Give 100mL of 10% glucose IV. Refer to MR846 for further management of hypoglycaemia. Inform medical team. Recommence insulin infusion at half the last tolerated rate when BGL ≥ 6.

INTRAVENOUS INSULIN (STANDARD VOLUME)

MR826