

# Clinical Support Guide | Intravenous Insulin Infusion (MR-INF-A) (MR-INF-B)

**Developed by:** CHSALHN Diabetes Service

**Approved by:** CHSALHN, Clinical Governance Committee on: 17/01/2019

**Next review due:** 17/01/2020

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## Version control and change history

Version	Date	Amendment	Amended by:
1.0	4/12/2015	Original version	Jane Giles
2.0	17/01/2019		Jane Giles

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# Clinical Support Guide | Intravenous insulin infusion

This clinical support guide is only for the management and titration of intravenous (IV) insulin infusion. It does not explain dose titration for any other type of insulin or method of administration.

## 1. Background

Hyperglycaemia on general medical and surgical units is associated with an 18 fold increase in in-hospital mortality, longer length of stay and greater risk of infection.<sup>1</sup> The use of IV insulin to treat hyperglycaemia has been shown to reduce mortality, sepsis and acute renal failure by up to 45%.<sup>2</sup>

## 2. Purpose

The aim of this document is to support best practice in the titration and stabilisation of the person with diabetes requiring an IV infusion of insulin. The clinical guide is to be used in conjunction with the CHSA Intravenous Actrapid Infusion Protocols (*MR-INF-A Adult - DKA/Type 1 and MR-INF-B Adult – HHS/Type 2 protocols*). Actrapid is the insulin of choice for IV insulin infusion.<sup>3</sup>

## 3. Indications for IV insulin infusion

For the purposes of this clinical guide, indications for use in CHSA hospitals are:

- > Diabetic ketoacidosis (DKA).
- > Hyperosmolar hyperglycaemic state (HHS).
- > Surgical management of type 1 and 2 diabetes.
- > Type 1 diabetes - patient not eating/fasting.

Careful consideration for use with:

- > Hyperglycaemia on admission or persistent hyperglycaemia during hospitalisation.

Situations where these protocols are not in scope thus not approved are:

- > Peri-partum management of diabetes (refer to SA Health Perinatal Guidelines for IV insulin protocol). Insulin and blood glucose are documented on the Partogram.
- > Paediatric patients. Consultation with a paediatrician or paediatric service is recommended. A written medication authority from a medical practitioner is required.

## 4. Nursing considerations

Number of nursing staff and frequency of observations will be determined by patient stability and treatment intensity. There is a need for a 1:1 or 1:2 nurse:patient ratio if an IV insulin infusion is used as hourly observations are required.

Observations include:

- > 2 intravenous lines setup plus syringe pump for IV insulin infusion
- > capillary blood glucose and blood ketone monitoring

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- > fluid balance record (catheterisation and hourly measures) calculate and report deficit or positive fluid balance hourly
- > pulse oximetry, temperature, pulse, respirations and blood pressure
- > cardiac monitoring if hyperkalaemia or hypokalaemia
- > level of consciousness - Glasgow coma scale (GCS).

## 5. Targets for blood glucose levels

The blood glucose level (BGL) target range during an intravenous insulin infusion is 6-10mmol/L for adult inpatients:

Figure 1: Target BGL range

<b>BGL Frequency</b> <input type="checkbox"/> Hourly <input type="checkbox"/> 2 Hourly* <small>* (only if BGL is within target range for at least 6 hours. If any alteration in insulin infusion rate, IV fluids or TPN revert to hourly BGL's.)</small>	<b>Dr's Name:</b> ..... <b>Signature:</b> ..... <b>Pager No:</b> .....	<b>Target BGL range:</b> (Please Circle) Adult Inpatient <b>7 to 10 mmol/L</b>
Review need for IV Insulin infusion daily before 12 pm. If continuing, rewrite on a new page.		

## 6. Frequency of blood glucose monitoring

All patients require hourly blood glucose monitoring for the duration of the infusion unless BGL has been within target range for at least six hours. In this situation, 2 hourly BGL's may be ordered by the medical practitioner. If there have been any change to the infusion rate, IV fluids or TPN, revert back to hourly monitoring.

## 7. Identifying the protocol type

There are two IV insulin infusion protocols. The required protocol should be specified by the medical practitioner.

- > MR-INF-A (DKA/Type 1) is an adult protocol to be used for patients with type 1 diabetes and in conjunction with the CHSA Diabetic Ketoacidosis (DKA) protocol.
- > MR-INF-B (HHS/Type 2) is also an adult protocol to be used for patients with type 2 diabetes and in conjunction with the CHSA Hyperglycaemia Hyperosmolar State (HHS) protocol.

## 8. Preparation of insulin infusion - Equipment

- > Actrapid insulin cartridge
- > Syringe driver pump
- > 50 unit (0.5mls) insulin syringe
- > 50 ml leur lock syringe
- > Blunt tip cannula
- > 'Medication added' label
- > Extension tubing
- > IV fluids (usually normal saline at commencement)
- > Giving set with anti-reflex valve



## 9. Preparation of insulin infusion

Some hospitals have access to IV infusion packs.



1. Draw up 50 units of Actrapid insulin in a subcutaneous insulin syringe.



2. Draw up 49.5mls of 0.9% sodium chloride (normal saline) in a 50ml leuc lock syringe.



3. Leave enough space in the normal saline syringe and inject the insulin into the syringe. This will make the solution up to 50mls in total.
4. Apply a blunt tip cannula and mix gently.
5. Attach a 'medication added' label to the syringe stating the quantities added of each medication as above. Concentration = 1 unit insulin per 1 ml of normal saline, ie 50 units in 50mls.



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6. Attach extension tubing to the syringe and manually prime the line with the insulin/saline solution.
7. Position the syringe on a syringe driver pump ensuring the flange of the barrel and base of plunger are firmly engaged.



8. Assemble IV fluids as ordered (usually normal saline) using a giving set with an anti-reflux valve. Prime the line and attach to the patients IV cannula. The insulin infusion line **MUST** be attached via a side-line port below the anti-reflux valve on the giving set.
9. Commence infusions as ordered.



**HHS/Type 2 Protocol - Adult**

**Figure 3: Intravenous actrapid infusion – HHS/Type 2 protocol (Adult)**

<p><b>INTRAVENOUS ACTRAPID INFUSION</b></p> <p style="background-color: yellow; display: inline-block; padding: 2px;"><b>HHS / TYPE 2</b></p> <p><b>PROTOCOL - ADULT</b> (MR-INF-B)</p>		Affix patient identification label in this box																																																					
Hospital: .....		UR Number: ..... Surname: ..... Given name: ..... Second given name: ..... D.O.B: ___ / ___ / ___ Sex: .....																																																					
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New patients always begin in the green column - Column 1

**Moving up** At each BGL measurement ask the following two questions

- Is the patient's BGL 10 mmol/litre or less?
- Has the BGL dropped by at least 2.5mmol/litre in the last hour?

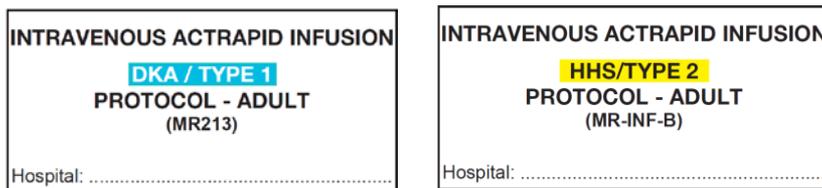
If the answer to **either** question is **YES** - patient remains in the current column.  
 If the answer to **both** questions is **NO** - patient moves up **one** column.

**Moving Down** If BGL <4.0 mmol/L for **Two consecutive** measurements or insulin has been switched off - patient moves down one column

**INTRAVENOUS ACTRAPID INFUSION  
STANDARD PROTOCOL - ADULT  
MR-INF-B**

## 10. Important points of difference between charts

- > Check title of chart to ensure you have the correct one.

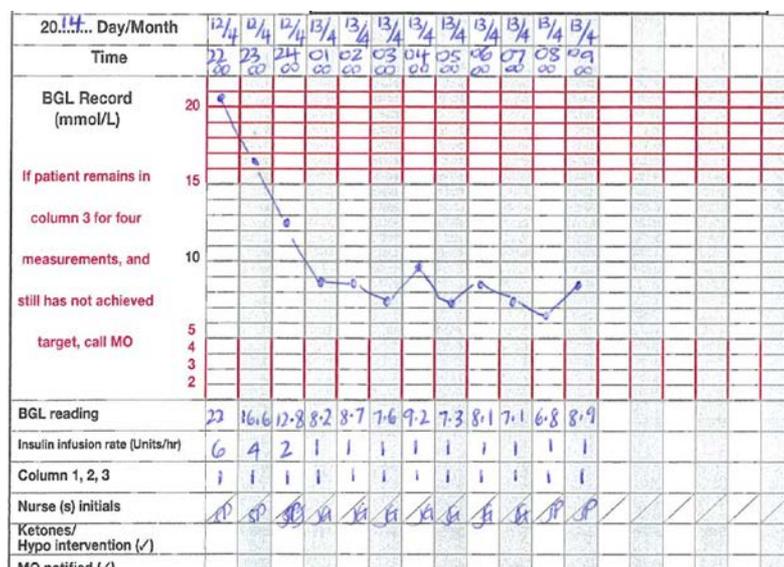


- > Column values for BGL and infusion rate are different.
- > Recording methods for all information are identical.

## 11. Documenting on the blood glucose monitoring section

- > Document the date and time in the appropriate column
- > The BGL is graphed with a dot (·) in the centre of the square which coincides with the BGL level. Eg 16.1 or 16.8 is a dot in the box that corresponds to 16. Connect to the previous dot with a straight line.
- > Document the numerical value of the BGL in the designated row below the graph.
- > Record IV insulin infusion rate as it relates to BGL. New patients always begin in the **green column** (column 1).
- > Record the column being used to titrate the infusion at that point in time eg column 1, 2 or 3.
- > Nurse taking and recording BGL to initial in allocated box.
- > If the Hypoglycaemia Protocol (see appendix 1) is initiated or a medical practitioner is contacted, tick the corresponding box on the chart.
- > Medical practitioner to be contacted if the patient remains in column 3 for four (4) measurements and has still not achieved target BGL.

Figure 4: example of how to chart the information



## 12. Intravenous insulin protocol

- > New patients always begin in the green column – Column 1.
- > **Moving up** – At each BGL measurement ask the following two questions.
  - > Is the patient's BGL 10mmol/litre or less?
  - > Has the BGL dropped by at least 2.5mmol/litre in the last hour?
  - > If the answer to **either question** is **YES** - patient remains in the current column.
  - > If the answer to **both questions** is **NO** - patient moves up **one column**.
- > **Moving down**
  - > If BGL <4.0mmol/L for **Two consecutive** measurements or insulin has been switched off – patient moves down **one column**.

## 13. Nursing medication administration record

At commencement of IV insulin infusion and with EACH syringe change, documentation required as below:

Figure 5: Example of how to complete the nursing administration record

NURSING ADMINISTRATION RECORD (Insulin IV infusion)					
Insulin (units) and sodium Chloride 0.9% (mL)	Date/time commenced	Nurse 1	Nurse 2	Time stopped	Volume infused (mL)
50 units Actrapid Insulin + 49.5mL Sodium Chloride 0.9%	12/4/14 2210	<i>Bullay</i>	<i>JGiles</i>	0910	21 ml
50 units Actrapid Insulin + 49.5mL Sodium Chloride 0.9%					
50 units Actrapid Insulin + 49.5mL Sodium Chloride 0.9%					

## 14. Medication management

- > Senior nurse to check the order and settings on the syringe driver at the commencement of their shift AND with each syringe change.
- > Check the IV insertion site and connections at commencement of each shift AND at each syringe/line change.
- > Always check the rate changes with a second nurse.
- > Change the Leur Lock Syringe every 24 hours. Lines replaced every 4 days.<sup>4</sup>

## 15. What can go wrong?

- > If the patient remains in column 3 for four (4) BG measurements, and still has not achieved target, call the supervising medical practitioner immediately.
- > Remember that this protocol has adjustments built in so that moving up and down will adjust for each person's individual insulin sensitivity. Hypoglycaemia, although always a possibility, will occur less frequently than with subcutaneous sliding scales.
- > At any time, a registered nurse should contact the prescribing medical practitioner if they have any concerns related to the IV insulin infusion or blood glucose results.

## 16. When to Stop/Suspend infusion

- > If hypoglycaemia occurs:
  - > suspend infusion and follow hypoglycaemia protocol
  - > notify the medical practitioner if infusion is suspended for >45 minutes.
- > Once the patient has remained in the same column for 10-12 hours with target BGL achieved, the medical practitioner can review for transition to alternate and appropriate method of blood glucose treatment.

## 17. Transition off IV insulin infusion

**IV insulin can only be discontinued once subcutaneous basal insulin has been on board for 4 hours.**

- > Patients **must not** have their IV insulin infusion discontinued until 4 hours after commencement of basal (e.g. glargine) subcutaneous insulin.
- > IV insulin (actrapid) has a half-life of only 7 minutes with a duration of only 1 hour.
- > IV insulin can only be discontinued once basal insulin has been on-board for 4 hours.
- > IV insulin adjustments can continue based on blood glucose levels as this ensures adequate insulin coverage during transition.

## 18. Switching from IV to the Basal Bolus Insulin protocol

- > Ensure long-acting insulin has been on board for a minimum of 4 hours before IV infusion is discontinued.
  - > Calculate total insulin required over the last 6 hours and multiply this amount by 4 (=TDD)
    - 50% of TDD is given as basal insulin
    - 50% of TDD is given in three divided doses with meal.
- > Continue to follow the protocol as outlined on the back of the Basal Bolus Insulin Chart.

## 19. Switching from IV to pre-mixed insulin

- > If pre-mixed insulin (twice/day) is chosen, 2/3 TDD is given at breakfast and 1/3 is given with the evening meal. Continue supplemental insulin.

## 20. Switching from IV to continuous subcutaneous insulin infusion (CSII) or insulin pump

- > A patient's endocrinologist should be consulted if transitioning to insulin pump therapy.
- > Insulin pump therapy is to be recommenced at the previous basal rate settings with the IV Infusion running concurrently.
- > IV Insulin Infusion rate will be titrated down based on blood glucose levels.
- > If a meal is due during the 4 hours of transition, the insulin pump's advanced settings are to be used to calculate the meal-related bolus.

The insulin pumps' advanced settings consider the pre meal blood glucose test result, blood glucose target, insulin sensitivity factor, insulin:carbohydrate ratio and insulin action time (also known as 'insulin on board') to suggest a meal-related bolus dose to be delivered.

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The patient can self-administered this suggested meal-related bolus dose or administer a reduction in the suggested dose if concerned about post prandial hypoglycaemia.

The CSII Inpatient Rate Record (MR-CIR) is to be used by the patient to document the meal-related bolus administered.

- > After at least 4 hours of basal insulin via the insulin pump **AND** if the patient has tolerated food and fluid **AND** if the blood ketone remains less than  $<0.3\text{mmol/L}$ , the IV infusion can be discontinued.
- > After the IV Infusion is discontinued, maintain insulin pump therapy (using both basal and advanced settings at main meal times). Continue hourly blood glucose for 2-4 hours then if stable, reduce blood glucose monitoring frequency to QID. The blood ketone should be rechecked in 1 hour and then as instructed by the medical officer.

### 21. Documentation

- > Capillary blood glucose levels
- > Insulin doses/infusion rate and any IV fluid therapy
- > Capillary blood ketone levels
- > Hypo treatments
- > Rate changes
- > Medical practitioner notifications

**Hypoglycaemia management**

The hypoglycaemia protocol below has been developed to standardise the management of hypoglycaemia in CHSALHN hospitals and aged care facilities. Two pathways are included on the flowchart (safe to swallow/unconscious or unsafe to swallow). This protocol still applies for patients on an insulin infusion.

**Figure 6: Hypoglycaemia protocol**

 Government of South Australia SA Health		Country Health SA Local Health Network <b>Protocol</b>	
<b>Treatment of hypoglycaemia in patients with diabetes</b>			
Indications: Blood glucose level (BGL) less than 4 mmol/L irrespective of symptoms. Adults (including diabetes in pregnancy): as per protocol below Paediatric: see below & consider consultation with paediatric service once patient stabilised.			
<b>A</b>	<b>Safe to swallow</b> (i.e. awake and co-operative)	<b>Unconscious or unsafe to swallow</b> <ul style="list-style-type: none"> <li>Place in coma position (if on insulin infusion or using an insulin pump – <b>suspend/disconnect</b> immediately).</li> <li>Notify doctor on call immediately (ie CODE BLUE). If no local doctor available call MedSTAR.</li> </ul> <p><b>Adults</b> – Give 1mg glucagon IM (as per CHSA standing order, once only).</p> <ul style="list-style-type: none"> <li>If no response to glucagon within 10 mins the doctor may then order: 20-30 mls IV / IO<sup>‡</sup> 50% Glucose in 50mls (slow push - 3mls/min). Followed by 5-10% Glucose infusion to maintain BGL 5-10 mmol/L.</li> </ul> <p><b>Child under 25kgs</b> Give 0.5 mg glucagon IM (as per CHSA standing order, once only).</p> <p><b>Infant/child/adolescent</b> IV / IO<sup>‡</sup> 10% Glucose in 100mls, 2ml/kg over 2 minutes. Followed by 5-10% Glucose infusion to maintain BGL 5-10 mmol/L.</p> <p><b>When conscious and safe to swallow GO TO B</b></p> <p>Commence maintenance IV glucose for prolonged hypoglycaemia or prevention of repeat episodes in high risk patients.</p>	
	If on insulin infusion <b>suspend</b> immediately.  If using insulin pump, <b>disconnect</b> if BGL less than 2 mmols/L	GO TO B	
<b>B</b>	Give 15g of fast acting carbohydrate. Hypo Kit: 60ml Carbotest (75 grams per 300ml) (See below for alternative options)* GO TO C		
<b>C</b>	<ul style="list-style-type: none"> <li>Repeat BGL 10 minutes after treatment.</li> <li>If BGL is less than 4 mmol/L OR patient still has symptoms and is assessed as:-                         <ul style="list-style-type: none"> <li>- safe to swallow – GO TO B</li> <li>- if BGL remains &lt;4.0mmol/L after 45 minutes or 3 oral cycles, <b>NOTIFY DOCTOR.</b></li> <li>- if unsafe to swallow – GO TO A</li> </ul> </li> <li>When BGL is 4 mmol/L or above <b>AND</b> symptoms are no longer present give 15g slow acting carbohydrate. Hypo Kit: 2 x sweet biscuit eg Arnotts 2 pack (See below for alternative options)*</li> <li>Recheck BGL in 30 mins.</li> </ul> <p style="text-align: center;">GO TO D</p>		
<b>D</b>	<ul style="list-style-type: none"> <li>If BGL remains above 4 mmols/L resume QID BGL monitoring and include 0200 for first 24hrs. <sup>▲</sup></li> <li>If the Doctor was not notified, do so at appropriate time so diabetes treatment can be reviewed.                         <ul style="list-style-type: none"> <li>- Recommence insulin infusion/reconnect insulin pump as per medical instructions</li> <li>- (in type 1 diabetes do not suspend / hold insulin for more than 1 hour).</li> </ul> </li> <li>Investigate cause. Review carbohydrate intake. May need adjustment of insulin/diabetes medication.</li> <li>Continue to administer insulin as prescribed, contact prescriber if concerned.                         <ul style="list-style-type: none"> <li>- Withholding the next insulin dose may result in hyperglycaemia.</li> </ul> </li> <li>Beware of recurrent hypoglycaemia – resume QID BGL monitoring and include 0200 for first 24hrs. <sup>▲</sup></li> </ul>		
<b>*Alternatives for Hypo Kit</b> <b>Fast acting carbohydrate</b> <ul style="list-style-type: none"> <li>100 mls Carbotest (50gm carbohydrate in 300 mls) OR</li> <li>90mls Lucozade (15gm equiv).</li> </ul> <b>Slow acting carbohydrate</b> <ul style="list-style-type: none"> <li>2 plain Milk Coffee, Arrowroot or similar OR</li> <li>6 Jatz.</li> </ul>		<b>Important points</b> – observe pulse and BP with event <ul style="list-style-type: none"> <li>Ensure maintenance IV glucose and/or adequate carbohydrate with meals to replenish the liver glucose stores.</li> <li><sup>‡</sup> Intraosseous route (IO) should only be used by staff who are trained and have achieved clinical competency.</li> <li><sup>▲</sup> If hypo was severe (eg BGL less than 2mmol/L, unconscious or assessed as unsafe to swallow) or prolonged (greater than 45mins) the patient should have hourly BGLs until medical review.</li> <li>Restock the Hypokit – discard all opened items.</li> </ul>	
Version: 2 Authorisation: CHSA LHN Clinical Governance Committee Author: CHSA Diabetes Service	Effective Date: 10 <sup>th</sup> December 2015 Next Review: October 2017 Page No: Page 1 of 1		

# Country Health SA Local Health Network

## 1. Attached Documents

Document Name
<a href="#">Treatment of hypoglycaemia in patients with diabetes protocol (2016)</a>

## 2. References

Document Name
1. Australian Diabetes Society, <i>Guidelines for routine glucose control in hospital</i> . 2012, Australian Diabetes Society: Sydney.
2. American Diabetes Association, 2015 <i>Standards of medical care in diabetes</i> . Diabetes Care. 38 (Supp 1).
3. Northern Adelaide Local Health Network, <i>The management of intravenous insulin infusions</i> . 2019, Lyell McEwin Hospital: Adelaide.
4. National Health & Medical Research Council, <i>Australian guidelines for the prevention and control of infection in healthcare</i> 2010, Commonwealth of Australia: Canberra.

## 3. Accreditation Standards

### National Safety and Quality Health Service Standards (NSQHSS)

1	2	3	4	5	6	7	8	9	10
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Governance for Safety and Quality in Healthcare	Partnering with Consumers	Preventing & Controlling Healthcare Associated Infections	Medication Safety	Patient Identification & Procedure Matching	Clinical Handover	Blood & Blood Products	Preventing & Managing Pressure Injuries	Recognising & Responding to Clinical Deterioration	Preventing Falls & Harm from Falls

### Evaluation and Quality Improvement Program (EQIP)

11	12	13	14	15
<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Service Delivery	Provision of Care	Workforce Planning and Management	Information Management	Corporate Systems and Safety

## 4. Consultation

Version	Consultation
1.0	Diabetes Specialist Nurse Network