

REGIONAL LOCAL HEALTH NETWORKS

# Protocol (clinical)

## Title: Diabetic Ketoacidosis Management in Adults

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<b>Summary</b>	This protocol outlines responsibilities and actions required by medical practitioners, nurses and midwives to ensure the safety and quality of inpatient care.
<b>Policy/procedure reference</b>	This protocol supports the SA Health Recognising and Responding to Clinical Deterioration Policy Directive and Guideline, Diabetes Service Plan and Diabetes Inpatient Model of Care.
<b>Keywords</b>	Clinical, protocol, medical, nursing, midwifery, emergency, safety, quality, standards, insulin, infusion.
<b>Document history</b>	Is this a new LHN protocol? <b>N</b> Does this protocol <i>amend or update</i> an existing protocol? <b>Y</b> <i>Diabetic Ketoacidosis Management in Adults with Type 1 Diabetes Protocol Objective No. 2020-20587</i> Does this protocol <i>replace</i> an existing document? <b>N</b>
<b>Applies to</b>	This protocol applies to all hospital medical practitioners, nursing and midwifery staff.
<b>Objective file number</b>	2020-02587

## Version control and change history

Version	Date	Amendment	Amended by:
1.0	13/04/2016	Original version	Jane Giles – Advanced Nurse Consultant
2.0	17/01/2019	New template	Jane Giles – Advanced Nurse Consultant
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4.0	10/08/2023	Reviewed and updated	Collette Hooper – Nurse Practitioner

## Table of contents

	page
Flowchart – Diabetic Ketoacidosis in Adults	3
Assessment of severity	4
1. Introduction	5
1.1 Diagnosis	6
1.2 Assessment of severity	6
1.3 Goal of treatment	7
1.4 Principles	7
1.5 Nursing considerations	8
1.6 Treatment plan – Part A. Within first hour	9
1.7 Treatment plan – Part B. 1 - 6 hours	11
1.8 Treatment plan – Part C. 6 - 12 hours	12
1.9 Treatment plan – Part D. 12 - 24 hours	13
1.10 After care	14
1.11 Appendix A – Regional LHN Intravenous Insulin Infusion Type 1 Diabetes Chart - Adult (MR-INF-T1D)	15
2. Linked Documents	17
3. References	17
4. Accreditation Standards	17
5. Consultation	18

Diabetic Ketoacidosis in Adults\* - Flowchart

Respond - 0-60 minutes

**Confirm**

- Blood ketones greater than or equal to 3.0mmol/L or urine ketones greater than or equal to 2+ on urinalysis dip-stick test.
- Known to have type 1 diabetes or blood glucose greater than 11.0mmol/L#,  
OR
- Known to have type 1 diabetes or type 2 diabetes, prescribed SGLT2i (euglycaemia e.g. blood glucose can be less than 14.0mmol/L#).
- Bicarbonate (HCO3-) less than 15.0mmol/L and/or venous pH less than 7.3.

See next page for assessment of severity  
Seek urgent advice from MedStar on 137 827

Respond - 0-60 minutes

**Actions and investigations**

- Assess**  heart rate  BP  respirations  Spo2  temperature  GCS **Actions**  2 x IV cannula
- Urgent**  VBG  UEC  LFT  plasma glucose  capillary blood ketones  osmolality  CPR  FBC  blood culture
- Other**  ECG  CXR  urinalysis

Respond & Escalate - >60 minutes

**IV fluids**  
IV 0.9% Sodium chloride  
1000ml/hour

**IV insulin**  
Commence IV Insulin Infusion  
Type 1 Diabetes Chart – Adult  
MR-INF-T1D

**IV potassium replacement**  
Commence potassium replacement as  
separate IV Infusion

IV 0.9% Sodium chloride		
Bag no.	Time (h)	Rate
2	1-3	500ml/hour
3	3-5	500ml/hour
4	5-9	250ml/hour
5	9-13	250ml/hour
6	13-19	166ml/hour

**If IV Insulin infusion is unfeasible**  
Seek advice from MedSTAR and administer bolus dose of subcutaneous rapid acting insulin (insulin aspart 100unit/mL) at 0.1units/kg.  
  
Continue subcutaneous rapid acting insulin 2 hourly (as per Treatment Plan A) until Medstar handover.

Serum Potassium (mmol/L)	Potassium replacement
greater than 5.5	Nil
3.5-5.5	Up to 30mmol <sup>^</sup>
less than 3.5	Seek advice from MedStar 137 827 re transfer to a suitably equipped and staffed HDU.

**Serum glucose less than 15.0mmol/L**  
**Option 1** – change IV fluids to 0.18% Sodium chloride + 4% glucose  
**OR**  
**Option 2** – commence 10% Glucose at 125mL/h AND continue 0.9% Sodium chloride solution

**Hourly monitoring of**  
Blood ketones  
Bicarbonate  
Blood glucose#  
  
**Commence long acting insulin**  
(e.g. insulin glargine 100unit/mL daily at 2100hour)

<sup>^</sup> Standard premixed potassium chloride solution, 10mmol potassium chloride in 100ml mini bags are the preferred option for replacement on general ward.  
  
Cardiac monitoring if potassium replacement.  
  
Review potassium levels before each bag of normal saline and replace as above.

\* DKA can occur in type 1 diabetes and type 2 diabetes (higher risk with sodium-glucose co-transporter 2 inhibitor (SGLT2i)).

# ePOC blood glucose limitation: result will be 'HI' if blood glucose greater than 38.0mmol/L.

<b>Assessment of severity</b> Seek urgent advice from MedStar on 137 827 if any of the listed criteria below is noted Recommend transfer to an appropriate regional HDU or metropolitan ICU	
<ul style="list-style-type: none"> <li>&gt; Blood ketones: greater than 6.0mmol/L</li> <li>&gt; Bicarbonate: less than 5.0mmol/L</li> <li>&gt; Venous/arterial pH: less than 7.1</li> <li>&gt; Hypokalaemia: less than 3.5mmol/L</li> <li>&gt; Glasgow Coma Scale (GCS): less than 12 or abnormal AVPU* scale</li> <li>&gt; Oxygen saturation: less than 92% on air (assuming normal baseline respiratory function)</li> <li>&gt; Systolic blood pressure: less than 90mmHg</li> </ul>	<ul style="list-style-type: none"> <li>&gt; Pulse: greater than 100 or less than 60 bpm</li> <li>&gt; Urine output: less than 0.5ml/kg/hour</li> <li>&gt; Serum creatinine: greater than 200µmol/L</li> <li>&gt; Microvascular event: myocardial infarction or stroke</li> <li>&gt; Other serious co-morbidity: end stage kidney disease, heart failure or conditions that would warrant admission to HDU in their own right                             <ul style="list-style-type: none"> <li>&gt; hypothermia</li> <li>&gt; 65+ years of age</li> <li>&gt; pregnancy.</li> </ul> </li> </ul>
* AVPU – Alert / Voice / Pain / Unresponsive	

**Ongoing local management.** Assess your site capacity to manage this medical emergency based on staff availability, qualification, experience and competency. The following criteria must be met:

	<b>Yes</b>	<b>No</b>
1) Availability of medical staff who are competent in managing DKA and can review the person frequently, and at short notice.	<input type="checkbox"/>	<input type="checkbox"/>
2) Availability of nursing staff who can provide 1:1 or 1:2 nursing care.	<input type="checkbox"/>	<input type="checkbox"/>
3) Availability of relevant point of care testing.	<input type="checkbox"/>	<input type="checkbox"/>

## 1. Introduction

Diabetic Ketoacidosis (DKA) is a life-threatening complication of type 1 diabetes mellitus. DKA can also occur in people with type 2 diabetes, and those prescribed a sodium-glucose co-transporter 2 inhibitor (SGLT2i) are at greater risk. **DKA is a medical emergency and must be diagnosed promptly and managed intensively.**

DKA is associated with significant morbidity and mortality and must be diagnosed promptly and managed intensively. DKA is a complex disordered metabolic state characterised by ketonaemia, hyperglycaemia (in most cases) and metabolic acidosis. DKA results from absolute or relative insulin deficiency accompanied by an increase in counter-regulatory hormones (glucagon, epinephrine, cortisol, growth hormone). In addition to the significant metabolic and electrolyte derangements, the person may have additional medical or surgical comorbidities, which may have triggered DKA such as sepsis.

The clinical presentation of DKA may present as:

- > new diagnosis of type 1 diabetes **OR**
- > inadequate insulin in the person with pre-existing type 1 diabetes **OR**
- > acutely ill in the person with pre-existing type 1 diabetes or type 2 diabetes prescribed an SGLT2i. Withhold this oral medication if DKA suspected.

**Seek urgent advice from MedSTAR on 137827**

**Most cases will mandate retrieval by MedSTAR to the appropriate metropolitan hospital.** Less severe cases (see page 6) may be managed at a regional hospital if resources are available.

**Obstetrics.** Pregnant women with diabetes are at a greater risk for DKA than those that are not pregnant. DKA has the potential for dire consequences for both mother and foetus. Treatment of DKA and intravenous fluid resuscitation requires immediate consultation with MedSTAR.

**Paediatrics.** This protocol is not to be used for children or young people under 18 years of age. Treatment of DKA and intravenous fluid resuscitation requires immediate consultation with MedSTAR with reference to the South Australian Paediatric Clinical Practice Guideline for [Diabetic Ketoacidosis in Children and Adolescents](#)

The aim of DKA treatment is:

- > restoring hydration
- > clearing ketones
- > correcting electrolyte losses (mainly potassium)
- > normalising blood glucose (BG).

## 1.1 Diagnosis

### DEFINITION AND DIAGNOSIS OF DKA

1. Blood ketones greater than or equal to 3.0mmol/L or urine ketones greater than or equal to 2+ on urinalysis dip-stick test.
2. Known to have type 1 diabetes or blood glucose greater than 11.0mmol/L.  
Known to have type 1 diabetes or type 2 diabetes, prescribed SGLT2i (euglycaemia e.g. blood glucose can be less than 14.0mmol/L).
3. Bicarbonate (HCO<sub>3</sub><sup>-</sup>) less than 15.0mmol/L and/or venous pH less than 7.3.

**Note:** Venous plasma glucose is recommended. The enterprise point of care (ePOC) system blood glucose will read 'HI' if the BG result is greater than 38.0mmol/L and the bedside Freestyle Optium Neo H blood glucose meter will read 'HI' if the BG is greater than 27.8mmol/L.

## 1.2 Assessment of severity

**Seek urgent advice from MedSTAR on 137827 if any of the listed criteria below is noted**  
**Recommend transfer to an appropriate regional HDU or metropolitan ICU**  
**Commence and continue treatment until patient medically handed over**

- > Blood ketones: greater than 6.0mmol/L
- > Bicarbonate: less than 5.0mmol/L
- > Venous/arterial pH: less than 7.1
- > Hypokalaemia: less than 3.5mmol/L
- > Glasgow Coma Scale (GCS): less than 12 or abnormal AVPU scale\*
- > Oxygen saturation: less than 92% on air (assuming normal baseline respiratory function)
- > Systolic blood pressure (BP): less than 90mmHg
- > Pulse: greater than 100 or less than 60 bpm
- > Urine output: less than 0.5mL/kg/hour
- > Serum creatinine: greater than 200µmol/L
- > Microvascular event: myocardial infarction or stroke
- > Other serious co-morbidity: end stage kidney disease, heart failure or conditions that would warrant admission to HDU in their own right
  - hypothermia
  - 65 years+ of age
  - pregnancy.

\*AVPU – Alert / Voice / Pain / Unresponsive



### 1.3 Goal of treatment

The aim of DKA treatment is:

- > restoring hydration
- > clearing ketones
- > correcting electrolyte losses (mainly potassium)
- > normalising BG.

Other goals include prevention of:

- > hypokalaemia
- > hypoglycaemia
- > cerebral oedema
- > arterial or venous thrombosis.

### 1.4 Principles

**This protocol is designed to be followed sequentially.**

- > IV 0.9% Sodium chloride solution is the preferred fluid to restore circulating volume and reverse dehydration. *See page 10 for rates.* If BG is less than 15.0mmol/L, change IV fluids to 0.18% Sodium chloride + 4% glucose + OR commence 10% Glucose at 125mL/h AND continue 0.9% Sodium chloride solution.
- > IV insulin infusion (regional LHN *Intravenous Insulin Infusion Type 1 Diabetes Chart – Adult (MR-INF-T1D)*). Insulin neutral 100units/mL (Actrapid®) is the preferred insulin for IV infusion. (*Appendix A*)
- > Do not use subcutaneous rapid acting insulin unless there is significant delay (greater than or equal to 1 hour) in commencing insulin infusion.
- > Monitor potassium level and replacement via IV fluid. *See page 10 for rates.*
- > Treatment targets
  - > reduction of blood ketone concentration by 0.5mmol/L per hour
  - > increase venous bicarbonate by 3.0mmol/L per hour
  - > reduce capillary BG by up to 3.0mmol/L per hour – glucose toxicity can exist, and the BG can take some time to reduce. If BG is reduced too quickly, cerebral oedema or other significant neurologic impairment can occur.
  - > potassium should be maintained between 4.0 – 5.0mmol/L.
- > Subcutaneous long acting insulin (e.g. insulin glargine 100units/mL) **SHOULD** be continued.
- > Bicarbonate administration is not recommended routinely.
- > Phosphate should not be supplemented routinely.

**Seek urgent advice from MedSTAR on 137827  
If being transferred, continue treatment until medical handover**

## 1.5 Nursing considerations

Level of nursing care and frequency of observations will be determined by patient stability and treatment intensity (e.g. a person will need a 1:1 or 1:2 nursing ratio as hourly observations are needed and an IV insulin infusion is used).

Nursing observations include;

- 1) Blood ketones.
- 2) Blood glucose: the ePOC system will read 'HI' if the BG result is greater than 38.0mmol/L and bedside Freestyle Optium Neo H blood glucose meter will read 'HI' if the BG is greater than 27.8mmol/L.
- 3) Fluid balance record: to calculate and report deficit or positive fluid balance hourly (e.g. catheterisation and hourly measures).
- 4) Pulse oximetry.
- 5) Pulse, respiration and blood pressure.
- 6) Cardiac monitoring if hyperkalaemia or hypokalaemia. Continue to cardiac monitor if requiring IV potassium replacement.
- 7) Level of consciousness - Glasgow coma scale (GCS).
- 8) Two (2) intravenous access lines are required:
  - a. one for the IV insulin infusion, the other for IV hydration and potassium replacement if required
  - b. IV potassium chloride replacement via additional port on the IV hydration line (e.g. piggyback) as the IV potassium infusion must not be run via the IV insulin infusion line.
- 9) An infusion pump or other rate limiting device must always be used for both an IV insulin infusion and IV potassium chloride. Refer to regional LHN *Use of Intravenous Potassium Chloride Procedure*.



## 1.6 Treatment Plan – Part A

**Within first hour: Immediate management upon diagnosis: 0 to 60 minutes (continuous on-site medical supervision is necessary).**

**Time = 0 when IV fluids are commenced. Any problem with IV access, seek urgent advice from MedSTAR on 137827.**

The aim within this time period is to:

Assess and decide if transfer of the person is required or they can be managed locally.

- 1) Commence IV 0.9% Sodium chloride – 1 litre to run over 1 hour:
  - > if systolic BP less than 90mmHg, give 500mL over 15 minutes and reassess  
rehydration may precipitate heart failure or insufficient hydration may fail to reverse acute kidney injury.
- 2) Commence IV insulin infusion (regional LHN *Intravenous Insulin Infusion Type 1 Diabetes Chart – Adult (MR-INF-T1D)*). For regional LHN hospitals using electronic medical records (EMR) order sets, further information is available at [Ordering Adult Insulin Infusions](#)
  - a. if site-specific assessment does not meet criteria for safe staffing and IV insulin infusion is not feasible, subcutaneous insulin should be commenced with a stat dose of 0.1units/kg via deep subcutaneous injection. This dose can be repeated 2 hourly to achieve a fall in blood glucose of up to 3.0mmol/L.
  - b. consult MedSTAR (or diabetes specialist) for additional IV insulin infusion adjustment if;
    - > column 3 is reached or a maximum level of 12 units is being used in column 3  
**OR**  
> BG is falling at a rapid rate (e.g. greater than 5.0mmol/L or more in last hour).Transfer to an appropriate HDU may be required.
  - c. additional subcutaneous rapid acting insulin is NOT recommended as the BG may decline too fast causing complications such as cerebral oedema.
- 3) Avoidance of hypoglycaemia:
  - a. review IV fluids
    - > if BG is greater than 15.0mmol/L, continue 0.9% Sodium chloride solution
    - > if BG is 15.0mmol or less, immediately commence 10% Glucose at 125 mL/hour AND continue 0.9% sodium chloride solution.
  - b. aim for BG between 10.0 – 15.0mmol/L in first 24 hours.
- 4) Establish monitoring regime:
  - a. venous plasma glucose on admission then 6-8 hourly; hourly venous plasma or capillary glucose or capillary (ePOC system will read 'HI' if BG is greater than 38.0mmol/L and Freestyle Optium Neo H blood glucose bedside meter will read 'HI' if BG is greater than 27.8mmol/L) (may use blood from arterial or CVC line to reduce finger trauma).
  - b. hourly urine output – fluid balance record (minimum urine output 0.5mL/kg/h).
  - c. 2 hourly serum potassium for the first six hours (*replace potassium as per table on page 11*).

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d. clinical assessment:

- > respiratory rate, temperature, blood pressure, pulse, oxygen saturation
- > hourly GCS – a drowsy person requires critical care input
- > examine for a source of sepsis or cause of DKA
- > continuous pulse oximetry
- > continuous cardiac monitoring.

5) Investigations:

- > venous blood gas (arterial blood gas if require pO2)
- > full blood count & blood cultures
- > ECG & chest x-ray
- > urinalysis and culture.

6) Commence DVT prophylaxis.

7) Assess for precipitating causes of DKA and commence treatment (e.g. consider IV antibiotics if sepsis identified or suspected).

**If patient not responding, seek urgent advice from MedSTAR on 137827**  
**If being transferred, continue treatment until medical handover**

**Suggested IV fluid regimen**

Bag no.	Time (hour)	Fluid	Rate	Potassium chloride (KCL)#
1	0-1	0.9% Sodium chloride	1000mL/hour	None <i>(may be required if more than 1 litre of IV fluid has been given to resuscitate if hypotensive)</i>
2	1-3	0.9% Sodium chloride	500mL/hour	<i>Monitor Potassium level &amp; replace with IV potassium chloride as per table on page 11.</i>
3	3-5	0.9% Sodium chloride	500mL/hour	
4	5-9	0.9% Sodium chloride	250mL/hour	
5	9-13	0.9% Sodium chloride	250mL/hour	
6	13-19	0.9% Sodium chloride	166mL/hour	
If BG is less than 15.0mmol/L, change IV fluids to 0.18% Sodium chloride + 4% glucose OR commence 10% Glucose at 125mL/h AND continue 0.9% Sodium chloride solution.				
<b>Reassessment of cardiovascular status at 12 hours is mandatory</b>				

# See **Treatment Plan B: 60 minutes to 6 hours** for potassium chloride replacement regimen.

## 1.7 Treatment Plan – Part B

### 60 minutes to 6 hours (continuous on-site medical supervision is necessary)

The aim of this time period is to:

- 1) Clear blood ketones and suppress ketogenesis:
  - > achieve a rate of fall of blood ketones of at least 0.5mmol/L per hour
  - > in the absence of blood ketone measurement
    - > bicarbonate should rise by 3.0mmol/L per hour
    - > BG is expected to fall by 2.5 - 3.0mmol/L per hour.

**If blood ketones are not falling as expected, check syringe driver & IV line connections.**

- 2) Maintain potassium in the normal range:
  - > hypokalaemia (less than 3.5mmol/L) or hyperkalaemia (greater than 6.0mmol/L) are life-threatening conditions and require care in a regional HDU or metropolitan ICU.

Potassium level in first 24 hours (mmol/L)	Potassium replacement
Greater than 5.5	Nil
3.5 – 5.5	30mmol
Less than 3.5	Seek urgent advice from MedSTAR on 137827 regarding transfer to appropriate HDU (e.g. may require replacement rate greater than 10.0mmol/hour)

- > 10mmol potassium chloride in 100mL mini bags is the preferred option for replacement. The maximum rate of potassium on a general ward is 10mmol/hr or 0.2mmol/kg/hr whichever is smaller.
- > Premix 30mmol potassium chloride in 1 litre 0.9% Sodium chloride for use in HDU only.

- 3) Review subcutaneous insulin needs:
  - > if not already administered, commence daily subcutaneous long acting insulin at the usual time
  - > administration of subcutaneous rapid acting insulin with IV insulin infusion as per regional LHN *Intravenous Insulin Infusion Type 1 Diabetes Chart – Adult (MR-INF-T1D)* without MedSTAR or diabetes specialist advice is NOT recommended. Glucose toxicity can exist in DKA and BG can take some time to reduce.
  - > review IV fluids when BG is 15.0mmol/L and commence either:
    - > **option 1** – 10% Glucose at 125mL per hour **AND** continue 0.9% Sodium chloride solution. This is the preferred option if BG is less than 15.0mmol/L and bicarbonate is less than 12.0mmol/L or is not rising by 3.0mmol/L per hour
    - OR**
    - > **option 2** – 0.18% Sodium chloride + 4% glucose.

**Do not cease IV insulin infusion until blood ketones are less than 0.6mmol/L and acidosis has resolved.**

- 4) Continue:
  - > hourly vital signs and GCS monitoring
  - > hourly fluid balance record (e.g. minimum urine output 0.5mL/kg/hour)
  - > venous blood gas for pH, bicarbonate and potassium at 6 minutes, 2 hours and then 2 hourly.

**If patient not responding, seek urgent advice MedSTAR on 137827  
If being transferred, continue treatment until medical handover**

## 1.8 Treatment Plan – Part C

### 6 to 12 hours

The aim of this time period is to:

- 1) Ensure that clinical and biochemical parameters are improving
  - > continue hourly BG and blood ketones
  - > take appropriate action as outlined in Part B.
- 2) Continue IV fluid replacement
  - > hourly fluid balance chart.
- 3) Continue IV insulin infusion if blood ketones persist
  - > adjust IV insulin infusion rate as per regional LHN *Intravenous Insulin Infusion Type 1 Diabetes Chart – Adult (MR-INF-T1D)*.
- 4) Continue treatment of any underlying precipitant.
- 5) Avoid hypoglycaemia
  - > when BG is 15.0mmol/L, change IV fluids to either:
    - option 1** – 10% glucose at 125mL per hour AND continue 0.9% Sodium chloride solution (preferred option if BG is less than 15.0mmol/L and bicarbonate is less than 12.0mmol/L or is not rising by 3.0mmol/L per hour)
    - OR**
    - option 2** – 0.18% Sodium chloride + 4% glucose.
- 6) Ensure referral has been made to the diabetes specialist nurse.
- 7) Refer to or consult with the person's diabetes specialist to identify discharge plan (e.g. subcutaneous insulin schedule and doses) and to discuss post discharge follow up requirements.

**If patient not responding, seek urgent advice MedSTAR on 137827**

**If being transferred, continue treatment until medical handover**

## 1.9 Treatment Plan – Part D

### 12 to 24 hours

**By 24 hours, the blood ketones and acidosis is expected to have resolved.**

The aim in this time period is to:

- 1) Ensure continuing improvement of clinical and biochemical parameters
  - > continue to monitor blood ketones (hourly if still present)
  - > hourly BG monitoring if IV insulin infusion is still required
  - > check venous pH, bicarbonate, potassium, blood ketones.
- 2) Continue IV fluid replacement if not eating and drinking.
- 3) Continue IV insulin infusion as per regional LHN *Intravenous Insulin Infusion Type 1 Diabetes Chart – Adult (MR-INF-T1D)* if ketonaemia persists.
- 4) Continue treatment of any underlying precipitant.

**Do not cease IV insulin infusion until blood ketones are less than 0.6mmol/L and acidosis has resolved.**

- 5) Transitioning to subcutaneous basal bolus insulin:
  - a. the subcutaneous **long acting insulin must be on board for at least 4 hours** before discontinuing IV insulin infusion
  - b. starting subcutaneous insulin in a person who was not previously known to have type 1 diabetes by:
    - i. calculate total insulin requirements (four times IV insulin infused in last 6 hours = Total Daily Dose (TDD))
    - ii. 50% of TDD is prescribed as the basal insulin (long acting insulin) dose
    - iii. 50% of TDD is prescribed in three equally divided doses with meals (rapid acting insulin)
  - c. the fasting BG reflects adequacy of long acting insulin
  - d. continue BG monitoring QID as per the regional LHN [Blood Glucose and Blood Ketone Monitoring Chart \(MR59H\)](#). Subsequent insulin dose adjustments may be necessary based on capillary BG.
- 6) If transitioning to insulin pump therapy (continuous subcutaneous insulin infusion), please consult with diabetes specialist or a diabetes specialist nurse for advice.

**If patient not responding, seek urgent advice MedSTAR on 137827**

**If being transferred, continue treatment until medical handover**

## 1.10 After care

All **people with pre-existing type 1 diabetes** should have their basal bolus insulin regimen or insulin pump therapy (continuous subcutaneous insulin infusion) re-established. Assess HbA1c to evaluate pre-admission glycaemic control and to identify any changes required for discharge.

Where the admission represented a **new diagnosis of type 1 diabetes**, basal bolus insulin regimen is to be continued. Refer to diabetes specialist nurse/diabetes team

In **type 2 diabetes where a SGLT2i was prescribed before admission**, re-commence this oral medication after investigation of risk (e.g. confirmed type of diabetes, history of insulin omission, low carbohydrate diet, other medications that may affect beta cell function) and when the person is eating and drinking normally.

Endocrinology follow up is highly recommended.


All people should receive appropriate diabetes specialist nurse consultation before discharge and follow up once discharged. The person's *Hyperglycaemia Action Plan* should be reviewed and reinforced.

**The person's general practitioner** should be provided with a detailed discharge summary as soon as possible.





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 <p><b>Government of South Australia</b> SA Health</p>	<p><b>INTRAVENOUS INSULIN INFUSION TYPE 1 DIABETES CHART - ADULT MR-INF-T1D</b></p>	<p>Affix patient identification label in this box</p>																									
	<p>Site/Facility: .....</p>	<p>U.R. Number: .....</p> <p>Surname: .....</p> <p>Given Name: .....</p> <p>Second Given Name: .....</p> <p>D.O.B.: ..... Sex/Gender: .....</p> <p>Visit No. (If applicable): .....</p>																									
<p><b>Indications for use</b></p> <ul style="list-style-type: none"> <li>Diabetic ketoacidosis (DKA) in a new diagnosis or in pre-existing type 1 diabetes.</li> <li>Euglycaemic DKA in pre-existing type 1 or type 2 diabetes prescribed a sodium-glucose co-transporter 2 inhibitor.</li> <li>Surgical management of pre-existing type 1 diabetes.</li> <li>Fasting or unable to tolerate food and fluids in pre-existing type 1 diabetes.</li> <li>Peripartum management of pre-existing type 1 diabetes.</li> <li>FeSS Sugar Protocol (Stroke management procedure &amp; protocol guideline).</li> </ul> <p><b>Not for use in:</b></p> <ul style="list-style-type: none"> <li>Paediatric patients: consultation with the MedSTAR paediatrician or paediatric service is recommended.</li> </ul>																											
<p><b>Blood glucose target &amp; frequency</b></p> <ul style="list-style-type: none"> <li>Blood glucose (BG) target range during an IV Insulin Infusion is 7.0 – 10.0mmol/L for adult inpatients.</li> <li>BG target for obstetric patients is determined by the consulting physician: generally 6.0 – 10.0mmol/L.</li> <li>DKA: hourly BG monitoring is required for the duration of the IV Insulin Infusion.</li> <li>Fasting: hourly BG monitoring is required for the duration of the IV Insulin Infusion.</li> <li>Perioperative: hourly or 2hourly, refer to perioperative instructions.</li> </ul> <p><b>Note:</b> ePOC point of care system will read 'HI' if the BG result is greater than 38.0mmol/L and bedside Freestyle Optium Neo H blood glucose meter will read 'HI' if the BG is greater than 27.8mmol/L. Reducing a 'HI' BG level when exact BG level is unknown is not recommended without MedSTAR or diabetes specialist advice.</p>																											
<p><b>Blood ketone monitoring &amp; frequency</b></p> <ul style="list-style-type: none"> <li>Hourly blood ketone (BK) monitoring while ketones are present, otherwise monitor QID.</li> <li>Do not cease IV Insulin Infusion until BK are less than 0.6mmol/L and acidosis has resolved.</li> </ul>																											
<p><b>Rapid Detection and Response Instructions</b></p> <table border="1" style="width: 100%;"> <tr> <td style="width: 50%; vertical-align: top;"> <p>Senior registered nurse (RN) review when:</p> <ul style="list-style-type: none"> <li>BG not returning to target at anticipated rate of 2.5 – 4.9mmol/L in last hour &amp; column escalation is pending.</li> <li>BG is greater than 20.0mmol/L in any column.</li> <li>BG is less than 4.0mmol/L.</li> <li>When IV Insulin Infusion has been switched off and when it is resumed.</li> </ul> </td> <td style="width: 50%; vertical-align: top;"> <p>Multi-disciplinary team (MDT) review when:</p> <ul style="list-style-type: none"> <li>BK not decreasing at anticipated rate of 0.5mmol/L per hour.</li> <li>BG is 15.0mmol/L or less, commence IV Glucose Infusion.</li> <li>Moving up one column.</li> <li>BG not decreasing at anticipated rate of 2.5 – 4.9mmol/L in last hour despite moving up one column or being in Column 3.</li> <li>12units/hour is being used in Column 3.</li> <li>BG decreasing too fast (e.g. 5.0mmol/L or more in last hour).</li> </ul> <p style="text-align: center;"><b>Consult MedStar as may require transfer to HDU or ICU</b></p> </td> </tr> </table>				<p>Senior registered nurse (RN) review when:</p> <ul style="list-style-type: none"> <li>BG not returning to target at anticipated rate of 2.5 – 4.9mmol/L in last hour &amp; column escalation is pending.</li> <li>BG is greater than 20.0mmol/L in any column.</li> <li>BG is less than 4.0mmol/L.</li> <li>When IV Insulin Infusion has been switched off and when it is resumed.</li> </ul>	<p>Multi-disciplinary team (MDT) review when:</p> <ul style="list-style-type: none"> <li>BK not decreasing at anticipated rate of 0.5mmol/L per hour.</li> <li>BG is 15.0mmol/L or less, commence IV Glucose Infusion.</li> <li>Moving up one column.</li> <li>BG not decreasing at anticipated rate of 2.5 – 4.9mmol/L in last hour despite moving up one column or being in Column 3.</li> <li>12units/hour is being used in Column 3.</li> <li>BG decreasing too fast (e.g. 5.0mmol/L or more in last hour).</li> </ul> <p style="text-align: center;"><b>Consult MedStar as may require transfer to HDU or ICU</b></p>																						
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<p>Medical emergency response (MER) review when:</p> <ul style="list-style-type: none"> <li>BG is less than 4.0mmol/L and has not responded to the Hypoglycaemia Protocol oral treatment in 45 minutes.</li> <li>Drowsy, confused, unsafe to swallow, unresponsive or unconscious.</li> <li>Breathing rapidly or having difficulty breathing or complaining of severe abdominal pain.</li> </ul> <p style="text-align: center;"><b>Consult MedStar as may require transfer to HDU or ICU</b></p>																											
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MR-INF-T1D INTRAVENOUS INSULIN INFUSION TYPE 1 DIABETES - ADULT

2. Linked documents (to be linked in approved documents)

Intravenous Insulin Infusion Type 1 Diabetes Chart – Adult (MR-INF-T1D) - Example
Intravenous Insulin Infusion in adults with diabetes who are fasting, receiving perioperative or intrapartum care or who have hyperglycaemia - Protocol
<a href="#">regional LHN Proc Use IV Potassium Chloride (sharepoint.com)</a>

3. References

Northern Adelaide Local Health Network (2019) Diabetic Ketoacidosis Management Pathway for Adults. Northern Adelaide Local Health Network, Adelaide.

Joint British Diabetes Societies Inpatient Care Group (2021) [The Management of Diabetic Ketoacidosis in Adults](#). June. National Health Service Diabetes, United Kingdom.

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Tamar Eshkoli, Leonid Barski, Yaniv Faingelernt, Alan Jotkowitz, Alona Finkel-Oron, Dan Schwarzfuchs, (2021) Diabetic ketoacidosis in pregnancy – Case series, pathophysiology, and review of the literature, *European Journal of Obstetrics & Gynaecology and Reproductive Biology*, volume 269, pages 41-46. Available at <https://www.clinicalkey.com.au/#!/content/playContent/1-s2.0-S0301211521010101?returnurl=https:%2F%2Flinkinghub.elsevier.com%2Fretrieve%2Fpii%2FS0301211521010101%3Fshowall%3Dtrue&referrer=>

B Hirsch, MD, Michael Emmett, MD. *Diabetic ketoacidosis and hyperosmolar hyperglycemic state in adults: Treatment*. UpToDate accessed 02/03/2022 at <https://www.uptodate.com/contents/diabetic-ketoacidosis-and-hyperosmolar-hyperglycemic-state-in-adults-treatment#H14>

Andrade-Castellanos CA, Colunga-Lozano LE, Delgado-Figueroa N, Gonzalez-Padilla DA. *Subcutaneous rapid-acting insulin analogues for diabetic ketoacidosis*. Cochrane Database of Systematic Reviews, Issue 1. 2016 Art. No.: CD011281. DOI:10.1002/14651858.CD011281.pub2.

Country Health SA Local Health Network (2019) Use of intravenous potassium chloride, Procedure. CHSA Drug and Therapeutics Committee, Adelaide.  
<https://sagov.sharepoint.com/sites/CHSAX/procedures/Documents/CHSALHN%20Proc%20Use%20of%20Intravenous%20Potassium%20Chloride.pdf#search=Procedure%20for%20the%20use%20of%20intravenous%20potassium%20chloride>

4. Accreditation standards

**National Safety and Quality Health Service Standards (2<sup>nd</sup> edition)**

1	2	3	4	5	6	7	8
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Clinical Governance	Partnering with Consumers	Preventing & Controlling Healthcare Associated Infection	Medication Safety	Comprehensive Care	Communicating for Safety	Blood Management	Recognising & Responding to Acute Deterioration



## 5. Consultation

Version	Consultation
1.0	Northern Adelaide Local Health Network, Diabetes and Endocrine Service, CHSA Diabetes Specialist Nurse Network.
2.0	Northern Adelaide Local Health Network, Diabetes and Endocrine Service, CHSA Diabetes Specialist Nurse Network.
3.0	Northern Adelaide Local Health Network, Diabetes and Endocrine Service, regional LHN Diabetes Specialist Nurses, regional LHN visiting Physicians, regional LHN Clinical Pharmacists, Executive Directors of Medical Services, LCLHN Emergency Nurses.
4.0	Northern Adelaide Local Health Network, Diabetes and Endocrine Service, LCLHN Division of Medicine, regional LHN Diabetes Specialist Nurses, regional LHN visiting Physicians, regional LHN Clinical Pharmacists, Executive Directors of Medical Services, LCLHN Emergency Nurses.

*This material is adapted from the Northern Adelaide Local Health Network Diabetes and Endocrine Service.*

*Regional Local Health Networks do not accept any responsibility for the use of this material outside the scope for which it has been designed. This information is not intended to replace professional judgement or experience.*