



Queensland
Government

Management of Diabetic Ketoacidosis in Adults (Age 16 Years and Over)

(Affix identification label here)

URN:

Family name:

Given name(s):

Date of birth:

Sex: M F I

WARNING

Diabetic Ketoacidosis carries a significant mortality rate and close monitoring is essential.
**IF THERE IS A SUSPICION OF CEREBRAL OEDEMA OR THE PATIENT IS NOT IMPROVING
CALL A CONSULTANT.**

Signs of cerebral oedema (see page 4) should be monitored throughout the first 24 hours

Protocol Use	This protocol is to be used for the management of Diabetic Ketoacidosis in adults over the age of 16 This protocol is NOT to be used for the treatment of; <ul style="list-style-type: none"> Hyperglycaemic Hyperosmolar State (HHS/HONK) The management of Diabetic Ketoacidosis in an Intensive Care Unit
Definition of DKA	Usually a history of Type 1 Diabetes with: <ul style="list-style-type: none"> Ketonemia/Ketonuria Metabolic acidosis (pH less than 7.35, bicarbonate (HCO₃) less than 15) Usually with hyperglycaemia
Clinical Signs & Symptoms	<ul style="list-style-type: none"> Hyperventilation Dehydration Abdominal pain Impaired consciousness
ICU Consultation	Refer to ICU for consultation if: <ul style="list-style-type: none"> pH less than 7.1 Altered level of consciousness Severe Hypokalemia (less than 3mmol/L) Severe Hyponatremia (less than 125mmol/L) Altered blood pressure/severe dehydration
Key Issues	<ul style="list-style-type: none"> Initial fluid management Early potassium replacement Early IV insulin initiation (titrated to BGL) Frequent monitoring

NB: A Medical High Acuity Care Area is an ideal setting to manage DKA

GRADING OF DIABETIC KETOACIDOSIS

Action in DKA:	Urine Ketone Level		Blood Ketone Level		Action if not in DKA <i>(being monitored for risk of DKA)</i>
<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: auto;"> <p>Continue to monitor 4-hrly until Ketone free</p> </div>	Large	more than 10mmol/L	Moderate/ Large	more than 1.4 mmol/L	Risk of DKA, urgent medical review
	Moderate	4.1 – 10mmol/L	Small	1 – 1.4 mmol/L	Risk of DKA, report to medical staff. Retest blood glucose & ketones in 2 hours
	Small	0.5 - 4mmol/L	Trace	Less than 1mmol/L	Retest blood glucose & ketones in 2 hours report to medical staff
	Negative	Less than 0.5mmol/L			Continue routine monitoring

POTASSIUM REPLACEMENT GUIDELINES

Maximum CONCENTRATION = 40mmol/L peripherally to prevent phlebitis
 EXCEPTION: **isotonic, premixed** potassium chloride 10mmol/100mL minibags (commercially premade, ready to use) can be given peripherally. **NOTE:** Minibags **MUST** be given via an infusion pump.

All potassium containing infusions must be given via an infusion pump or burette

Maximum RATE:

- With burette = 10mmol/hr
- With infusion pump = 20mmol/hr

If maximum rates or concentration are exceeded, cardiac monitoring in a high acuity bed, as well as administration through a large vein with high blood flow (eg. CVC, venous access port, PICC) is required

For further information on Potassium replacement please refer to the Medication Services Queensland Prescribing Guidelines on Intravenous Fluids and Electrolytes

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This Clinical Protocol is a general guide and does not replace clinical judgement

Care should be individualised to meet the specific needs of each patient

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URN:

Family name:

Given name(s):

Date of birth:

Sex: M F I

Date: _____ Initiating MO: _____ Initiating MO to print patient name: _____

Time Commenced: _____ *Tick each step as it is initiated.*

IMMEDIATE MANAGEMENT 1 st Hour (On Presentation)	ONGOING MANAGEMENT HOURS 2 - 4	SUBSEQUENT MANAGEMENT	CONTINUING CARE												
STEP 1 - Initial Investigation	STEP 1: Reassess Patient, Monitor Vital Signs	STEP 1: Reassess Patient, Monitor Vital Signs	STEP 1: Refer For Specialist Review Before Discharge												
<input type="checkbox"/> Two IV Cannulas	<input type="checkbox"/> Catheter if oliguric	<input type="checkbox"/> Allow oral intake if bowel sounds present	<input type="checkbox"/> Refer to specialist to determine <ul style="list-style-type: none"> • Cause of DKA episode • For Diabetes education and review of knowledge and understanding of condition 												
<input type="checkbox"/> FBE, U&E, LFT, Blood Glucose (BGL), Venous Blood Gases	Continue 0.9% Sodium Chloride <ul style="list-style-type: none"> <input type="checkbox"/> 500mls/hr for 'hour 2' <input type="checkbox"/> 500mls/hr for 'hour 3' <input type="checkbox"/> 250mls/hr for 'hour 4' 	<input type="checkbox"/> Measure Bicarbonate twice daily initially until within reference range	STEP 2: Patient Not To Be Discharged Until												
<input type="checkbox"/> Urine/Blood Ketones	<input type="checkbox"/> Give 10% Glucose 100mL/hr via "Y" site when BGL less than 14mmol/L (second cannula)	<input type="checkbox"/> Continue 10% Glucose to maintain BGL between 9 -14mmol/L – Suggested dosage	<input type="checkbox"/> Normal ketones and electrolytes												
<input type="checkbox"/> Blood Culture	<input type="checkbox"/> Give Potassium (K ⁺) infusion OVER ONE HOUR via "Y" site unless anuric or K ⁺ more than 5mmol/L <ul style="list-style-type: none"> • If serum K⁺ 3.5 – 5mmol/L give 10mmol/100mls • If serum K⁺ < 3.5mmol/L give 2 x 10mmol/100mls 	<table border="1"> <thead> <tr> <th>Glucose</th> <th>Insulin</th> <th>10% Glucose</th> </tr> </thead> <tbody> <tr> <td>more than 14mmol/L</td> <td>6 units/hr</td> <td>Nil</td> </tr> <tr> <td>9-14mmol/L</td> <td>3 units/hr</td> <td>100ml/hr</td> </tr> <tr> <td>less than 9mmol/L</td> <td>2 units/hr</td> <td>200ml/hr</td> </tr> </tbody> </table>	Glucose	Insulin	10% Glucose	more than 14mmol/L	6 units/hr	Nil	9-14mmol/L	3 units/hr	100ml/hr	less than 9mmol/L	2 units/hr	200ml/hr	<input type="checkbox"/> Eating normally and established on routine subcutaneous insulin
Glucose	Insulin	10% Glucose													
more than 14mmol/L	6 units/hr	Nil													
9-14mmol/L	3 units/hr	100ml/hr													
less than 9mmol/L	2 units/hr	200ml/hr													
<input type="checkbox"/> ABG if pH less than 7.1	STEP 2: Further Monitoring, Continuation of Insulin	<input type="checkbox"/> Continue 0.9% Sodium Chloride infusion less than or equal to 150mL/hr until bicarbonate is in reference range and patient is eating	STEP3: Follow Up												
STEP 2 – Fluid Replacement	<input type="checkbox"/> Hourly BGL	<input type="checkbox"/> Continue Potassium replacement to maintain within reference range and continue to monitor potassium twice daily	<input type="checkbox"/> Arrange appropriate follow up/contact with diabetes educator and dietitian within one week of discharge												
<input type="checkbox"/> 0.9% Sodium Chloride 1000mL/hr	<input type="checkbox"/> Continue insulin 6 units/hr until BGL less than 14mmol/L then <ul style="list-style-type: none"> <input type="checkbox"/> 3 units/hr or variable rate to maintain BGL (9-14mmol/L) 	<input type="checkbox"/> Initiate/continue long acting insulin	<input type="checkbox"/> Ensure patient has a formal clinic appointment												
STEP 3 – Start Insulin	U&Es and venous gas at end of 'hour 2' and end of 'hour 4'	STEP 2: Continuation of Intravenous Insulin	<input type="checkbox"/> Ensure that a copy of patient discharge letter is sent to patient's GP and diabetes care team												
<input type="checkbox"/> Soluble, 6 units/hr IV (hold insulin until potassium is more than 3.0mmol/L – recheck hourly). In some people glucose will continue to rise requiring more insulin (to be prescribed on Insulin Infusion Chart)	<input type="checkbox"/> Hour 2 <input type="checkbox"/> Hour 4	<input type="checkbox"/> Measure BGL 2 hourly (hourly if BGL less than 5mmol/L or more than 10mmol/L)	MEDICAL OFFICER SIGNATURE LOG												
STEP 4 – Other Interventions	STEP 3: Consider Precipitating Factors	<input type="checkbox"/> Continue Insulin 3 units/hour or variable rate to maintain BGL (9-14mmol/L)	DATE TIME SIGNATURE												
<input type="checkbox"/> Maintain airway	If indicated/not checked already:	<input type="checkbox"/> Continue Insulin 3 units/hour or variable rate to maintain BGL (9-14mmol/L)													
<input type="checkbox"/> Fluid balance chart	<input type="checkbox"/> CXR <input type="checkbox"/> Blood Cultures	<input type="checkbox"/> When eating and biochemically stable, stop IV fluids and convert back to usual subcutaneous insulin regimen. Ensure long acting insulin is given													
<input type="checkbox"/> Commence neurological observations	<input type="checkbox"/> ECG <input type="checkbox"/> Viral titres														
<input type="checkbox"/> DVT prophylaxis	<input type="checkbox"/> MSU <input type="checkbox"/> LP														
<input type="checkbox"/> Undertake Septic screen and consider antibiotics for infection															
<input type="checkbox"/> Consider cardiac monitoring															
<input type="checkbox"/> Consider NGT if protracted vomiting/risk of aspiration															



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Date: _____ **Time treatment commenced:** _____

Hour: _____

Mental Status* _____

Vital Signs

Temperature _____

Pulse _____

Respiration (rate & depth)• _____

Blood Pressure _____

Chemistries

Serum glucose _____

Serum ketones _____

Urine ketones _____

Serum Sodium _____

Serum Potassium _____

Serum Chloride _____

Serum Bicarbonate _____

Urea _____

Effective osmolality◇ _____

Anion gap _____

Blood Gases

pH specify Venous (V) or Arterial (A) _____

pO₂ _____

pCO₂ _____

SpO₂ _____

Fluid/Metabolites (ml/hr)

10% Glucose _____

0.9% Normal Saline _____

Potassium 10mmol/100ml _____

Input

IV (mL) _____

Oral/NGT (mL) _____

Output

Urine (mL) _____

Other (mL) _____

Other (specify)

LEGEND

* **A:** Alert, **D:** Drowsy, **S:** Stuporous, **C:** Comatose • **D:** Deep, **S:** Shallow, **N:** Normal ◇ [2 x Na (mmol/L)] + [glucose (mmol/L)]

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Version 1.3 LR: 10/11 Developed by Queensland Health Townsville

SUPPLEMENTARY NOTES

IMMEDIATE MANAGEMENT		ONGOING MANAGEMENT	CONTINUING CARE
<p>1. Acute Management of Diabetic Ketoacidosis in Adults This protocol is for the acute management of diabetic ketoacidosis in patients 16 years and over. WARNING: Due to the significant mortality that this condition carries, the following clinical signs would indicate the need for close monitoring. Always discuss these clinical signs and management decisions with senior team members.</p> <ul style="list-style-type: none"> Respiratory Rate more than 20/min Pulse more than 90/min Systolic BP less than 100mmHg Circulatory compromise; pale, sweaty, cool or clammy peripheries – mottling indicates severe circulatory compromise Temp more than 38°C or less than 36°C Altered level of consciousness Consider central line <p>2. Signs of Cerebral Oedema Children and adolescents are at the highest risk of cerebral oedema <i>How will it present:</i></p> <ul style="list-style-type: none"> Headaches Reduced conscious level <p><i>How to take action:</i></p> <ul style="list-style-type: none"> Monitoring for signs of cerebral oedema should start from the time of admission and continue up to at least 24 hours after admission Administer IV Mannitol (100mls of 20% over 20 minutes or Dexamethasone 8mg (discuss with the Consultant)) Undertake CT scan to confirm findings Consider ICU (an indication for checking arterial blood gases) 	<ul style="list-style-type: none"> If there is suspicion of cerebral oedema or the patient is not improving within 4 hours of admission, call the Consultant <p>3. Fluid Replacement</p> <ul style="list-style-type: none"> Avoid using 0.45% (half normal) saline as there is no evidence to suggest that this is of benefit in the management of DKA Prescribed fluid resuscitation will meet the needs of people within the 50 – 90kg range. Fluids will need to be carefully reviewed and possibly modified if outside this weight range <p>4. Start Insulin</p> <ul style="list-style-type: none"> Use any soluble insulin eg: Actrapid, Humulin R. Concentration should be 50 units of insulin in 49.5mLs 0.9% normal saline through a syringe driver <p>5. Other Interventions <i>Guidance on Bicarbonate:</i> There is no evidence to support the use of bicarbonate unless there is evidence of cardiogenic shock or other lactic acid-generating conditions with markedly low pH <6.9. Must be given with Consultant authority <i>Guidance on Phosphate:</i> There is no evidence to support the use of Phosphate replacement unless severe hypophosphatemia (more than 0.4mmol/L). Must be given with Consultant authority <i>Guidance on Ketones:</i> Ketone testing is essential for diagnosis of DKA and can indicate effectiveness of management. Urine and blood ketone meters measure different ketones. Urine ketones may paradoxically rise initially and fall later but this does not mean treatment is ineffective. Urine ketones are cleared slowly. Blood ketones are more useful in monitoring progress. Monitor blood ketones four hourly until ketone free. If not in DKA and with raised glucose levels recheck ketones in two hours</p>	<p>6. Reassess Patient, Monitor Vital Signs <i>Potassium Replacement:</i> Potassium should not be administered at a rate greater than 20mmol/hr except in the first 4 hours (maximum 40mmol/hr) without Consultant authority. <i>Introduce Glucose:</i> Glucose should be introduced in conjunction with 0.9% normal saline. Evidence for using 10% Glucose is lacking and mainly anecdotal. However, at this concentration, higher insulin levels can be maintained with enhanced clearance of ketones. It is not meant for re-hydration but glucose control</p> <p>7. Further Monitoring, Continuation of Insulin <i>Laboratory Blood Glucose Testing:</i> While there is no specific evidence suggesting avoiding a rate of drop of blood glucose level of 5mmol/hr, there may be an increased risk of cerebral oedema if blood glucose levels drop too quickly. If blood glucose is less than 14mmol/L, the infusion rate of Glucose should be increased</p> <p style="text-align: center;">SUBSEQUENT MANAGEMENT</p> <p>8. Continuation of Intravenous Insulin Long acting (basal) subcutaneous insulin can be introduced in combination with intravenous insulin A point of care blood glucose meter can be used to monitor blood glucose level if the person is not peripherally shut down</p> <p>9. Consider Precipitating Factors Common causes include:</p> <ul style="list-style-type: none"> Omission of insulin Infection Newly diagnosed Diabetes Mellitus Myocardial Infarction Combination of the above 	<p>10. Refer for Specialist Review Before Discharge <i>Specialist Review:</i> Some or all of the following professions should be part of the Diabetes Specialist Review Team;</p> <ul style="list-style-type: none"> Diabetes Educator Dietitian Physician specialising in diabetes. <p><i>Problems contributing to DKA Episode:</i></p> <ul style="list-style-type: none"> Errors in insulin administration Faulty equipment Practical problems <p>In patient presenting with DKA (especially recurrent DKA) there may be psycho-social issues requiring psychological support</p> <p><i>Diabetes Education:</i> Some or all of the following aspects should be considered and discussed between the Diabetes Educator/Dietitian and patient:</p> <ul style="list-style-type: none"> Revision of patient knowledge and understanding of the condition Review of “Sick Day Plan” Equipment – pens, syringes and pumps Home blood glucose monitoring Diet <p>All Medical Officers documenting on this protocol must sign the signature log on page 2</p> <p>Feedback to: sanglak@health.qld.gov.au Developed July 2009 Modified October 2011 Next review October 2012</p>