Definition: pH< 7.3 or HCO_3 <18 + Lab BG* >11 + Ketonaemia ≥3.0 mmol/l)
(*BG may be normal if existing diabetes or on SGLT2i – 'gliflozin')

Apply patient ID label

Mersey and West Lancashire (Whiston & St Helens) Teaching Hospitals NHS Trust

Adult Diabetic Ketoacidosis (DKA)

Clinical Management Pathway

Version 10c, Nov 2024, Review Oct 2027.

MWL Adult Diabetic Ketoacidosis (DKA) Management Chart V10c (Whiston & St Helens Hospitals, Nov 2024). Page 2 of 11	Apply patient ID label
Definition: pH< 7.3 or HCO_3 <18 + Lab BG* >11 + Ketonaemia ≥3.0 mmol/l (*BG may be normal if existing diabetes or on SGLT2i – 'gliflozin')	

How to use this booklet

Read the guideline notes below in **Section 1** and then using these notes as a guide (see also MWL Adult Diabetes Guidelines on the trust intranet), complete **Sections 2, 3 and 4** to document the patient's DKA management. This is not a prescription chart and it is not a substitute for other parts of the health record – these other notes and other documents must still be completed.

Important Note – September 2024

Collective MDT review of a new version of our adult DKA guideline harmonised with the new joint American/European Consensus statement on the management of DKA provoked considerable concerns from medical and nursing members of the specialist diabetes team that elements of the new consensus approach were impractical for safe and effective delivery of DKA care at Whiston Hospital at the present time. This version and the accompanying revised DKA Management Booklet therefore represent a pragmatic compromise between alignment with international consensus and safe and effective local DKA care.

Section 1 - Guideline

Diagnosis	Typically polyuria, polydipsia, thirst, weight loss, vomiting, dehydration, abdominal pain, and hyperventilation. Usually alert.
AND	**pH < 7.3 or HCO_3 < 18 mM and ketonaemia ≥ 3 mM and BG > 11 mmol/l (any BG qualifies in pre-existing diabetes or SGLT2i (gliflozin) treatment).**
Clinical	Confirm diagnosis, seek cause (esp. infection/ischaemia), assess CVS/RS/CNS. Consider alternative diagnoses: alcohol/starvation/pregnancy/hyperemesis ketoacidosis.
Laboratory	Check lab BG, U&E & venous pH. Do ECG. Consider individually relevant tests for infection guided by the patient and clinical presentation. Remember temperature is often low/normal in DKA (vasodilatation) and WCC is invariably raised secondary to ketonaemia – beware infection.

MWL Adult Diabetic Ketoacidosis (DKA) Management Chart V10c (Whiston & St Helens Hospitals, Nov 2024). Page 3 of 11

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General Add Enoxaparin 40 mg o.d. (if not contraindicated). Monitor GCS + NEWS2. STOP SGLT2i & GLP-RA permanently. IV bicarbonate Rx is not recommended.

Management NEW from July 2024: DKA is classified: Mild, Moderate or Severe. Use this DKA BOOKLET to guide and record management.

MILD **Diabetes or BG > 11.0 and ketones 3-6 and pH 7.26-7.29 and HCO3 15-18**
MODERATE **Diabetes or BG > 11.0 and ketones 3-6 and pH 7.00-7.25 and HCO3 10-14.9**
SEVERE **Diabetes or BG > 11.0 and ketones >6 or pH <7.0 or HCO3 <10**

There is a recommendation to consider subcutaneous insulin to manage uncomplicated mild or moderate DKA in ED or in a nurse-led 'step-down area' but it was the view of our inpatient specialist doctors and nurses that this was impractical at Whiston at present, not only because of a drive to try to move patients out of ED to prevent congestion, but also because of concerns about the practicalities of safe use of subcutaneous insulin and monitoring in this context.

Transfer of mild and moderate DKA patients to enhanced monitoring on an assessment unit is appropriate, but as stated in the new international guidance and in existing UK guidance, ALL patients with severe DKA and all DKA in pregnancy should be referred to ICU immediately (not necessarily for organ support but for intensive monitoring and sometimes complex metabolic intervention such as in the management of potentially life-threatening changes in serum potassium). No patient with DKA should be managed on a corridor.

Treatment Start fluids immediately. Start insulin if gas machine $K^+ \geq 3.5$mmol/l. If $K^+ < 3.5$ mmol/l, hold insulin & discuss at once with Senior who should consider giving KCL by IV infusion at a rate of 10-20 mmol per hour until K+ ≥ 3.5mmol/l. We would strongly recommend that specific interventions for hyperkalaemia and hypokalaemia in DKA are managed on ICU.

Fluids Fluid replacement is dictated by hydration & health status. Ideally Ringer's solution may lead to faster resolution, shorter length of stay and less hyperchloraemic acidosis, but pragmatically use of 0.9% saline is satisfactory.

Typically, give 0.5-1.0 litre/hr over first 2 hr and then correct remaining fluid deficit over 24-48 hr (informed by HR, BP, fluid balance charts and serum Na). Typically, you might expect total fluid deficit to be of the order of 3-5 L, but each patient should have fluid replacement tailored to their hydration status and co-morbidities (and the rationale for your choice should be documented in the health record).

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…Fluids cont'd

For conditions where fluid replacement is more critical and there is a greater risk of fluid overload, e.g. pregnancy, frailty, heart failure or CKD 3B or worse, consider regular 250 ml boluses guided by frequent assessment rather than a continuous infusion with less frequent assessment. We would strongly recommend that complex fluid replacement in DKA is managed on ICU.

If in doubt, seek senior advice without delay.

Potassium

Await K+ result before using KCL. Only use 0.9% saline pre-constituted bags. If K+ > 5.0 mmol/l, use fluid without KCL; if K+ 3.5-5.0 mmol/l, use bag with 10-20 mmol KCL per litre; if K+ <3.5 mmol/l (5-10% DKA patients), hold insulin and discuss at once with Senior who should suspend IV insulin and consider giving KCL by IV infusion at a rate of 10-20 mmol per hour until K+ >3.5 mmol/l. Severe hypokalaemia K+ ≤ 2.5 mmol/l is an emergency associated with 5-fold increased mortality risk – contact ICU immediately. We would strongly recommend that specific interventions for hyperkalaemia and hypokalaemia in DKA are managed on ICU.

If in doubt, seek senior advice without delay.

Insulin

Once DKA confirmed, give 1 x (STAT) dose of 0.3 units/kg insulin Toujeo subcutaneously AND start Humulin S at a rate of 0.1 units/kg/hr by IV infusion pump. Once BG < 14 mmol/l (or if initial BG < 14 mmol/l), halve IV insulin infusion to 0.05 units/kg/hr and add 10% dextrose IV initially at 80 ml/hr - **adjust IV 10% Dextrose infusion** to maintain target BG 6 - 12 mmol/l until DKA resolved (see return to S/C below for 'resolved' and Section 2 'ongoing management' below for suggested adjustments to IV Dextrose 10% infusion if BG out of range); continue any IV saline (with or without KCL guided by U&Es). You must use pumps that alarm if either infusion fails – use a bifurcated or trifurcated extension set ("octopus").

If in doubt, seek senior advice without delay.

Monitoring

Check hourly capillary BG. Check first U&E at 2 hr, and check U&E, PO_4^{3-}, creatinine (eGFR), ketone and venous pH every 4 hours. Check serum K+ every 2 hr if <3.5 or >5.0 mmol/l.

If untoward results or doubt, seek senior advice without delay.

Phosphate

Treatment of low PO_4^{3-} is controversial and should only be considered by senior intensivists on ICU – there is a significant risk of precipitating hypocalcaemia and little evidence of clinically relevant benefit.

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Return to S/C

Resume subcutaneous long-acting insulin at patient's usual time and dose on day after admission; resume other insulins when well and pH ≥7.3 or HCO3 ≥ 18 & blood ketones falling (ideally < 0.6). Commence subcutaneous insulin at least 1-2 hr before stopping IV insulin infusion (and 10% Dextrose) and patients usually treated by S/C insulin (CSII pump) must have had a mealtime bolus before stopping IV insulin (and IV dextrose 10%) (see also inpatient insulin pump guidance due imminently). For newly diagnosed Type 1 diabetes, calculate total daily insulin dose as 0.5 units/kg, then give half (0.25 units/kg) as long-acting insulin Toujeo at bedtime and give the other half, in three equal divided doses 15 minutes before meals.

For example, for a 72 kg person,

Total daily dose = 0.5 units/kg = 36 units.

Give half (0.25 units/kg) as bedtime long-acting insulin Toujeo = 18 units

And half as rapid-acting insulin (e.g. Insulin Trurapi) (0.25 units/kg) divided equally between the 3 meals = 18/3 = 6 + 6 + 6. If in doubt ask the IP Diabetes Specialist Nurse.

Aftercare

Assess for complications. Refer all DKA patients to Diabetes Specialist Team without delay and before discharge to try to prevent recurrence, which is common and associated with increased mortality.

MWL Adult Diabetic Ketoacidosis (DKA) Management Chart V10c (Whiston & St Helens Hospitals, Nov 2024). Page 6 of 11

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Important Note: Black boxes = anticipated care – expect these to be ticked. Red boxes = ALERT – you MUST discuss with a SENIOR

Section 2 - Initial management

Initial Assessment & Management	Y	N	Notes (If N for any answer, record comments in 'notes' section)
Suspect DKA? Do venous gas, lab BG, U&E, capillary blood ketone	☐	☐	See 'diagnosis' & 'clinical'. Use ketone meter for blood ketone.
Confirm diagnosis, consider alternatives & seek cause.	☐	☐	See 'diagnosis' 'clinical' and 'laboratory'.
Assess CVS/RS/CNS & feet and do ECG.	☐	☐	See 'clinical' and 'laboratory'.
Add Enoxaparin 40 mg o.d. if not contraindicated	☐	☐	See 'general'.
Start monitoring for GCS and NEWS2.	☐	☐	See 'general'.
Stop SGLT2i & GLP-RA Rx permanently (also tick Y if not on them).	☐	☐	See 'general'.
Classify DKA as mild, moderate or severe.	☐	☐	See 'management'.
Refer severe DKA & DKA in pregnancy to ICU; 'appropriate' for rest	☐	☐	See 'management'. 'Appropriate' = AMU enhanced monitoring; not corridors.
Prescribe usual dose of usual (regular) long-acting insulin	☐	☐	Set start date as day AFTER admission because Toujeo stat dose (see 'Insulin').
Prescribe and start IV fluids	☐	☐	See 'fluids'. Use 0.9% saline. Involve senior if pregnancy, frailty, CCF or CKD.
Prescribe and administer Insulin Toujeo S/C STAT 0.3 units/kg	☐	☐	See 'insulin'. This is why regular long-acting insulin starts on Day 2.
Prescribe & prepare IV insulin infusion Humulin S (0.1 units/kg/hr)	☐	☐	See 'insulin'. Administration via IV insulin infusion pump – see below re start.
Check gas machine K+ and if > 3.5 mmol/l start IV insulin	☐	☐	See 'treatment'; if K+ < 3.5, tick N, don't start insulin & contact senior at once.
Establish a monitoring plan for hourly capillary blood glucose.	☐	☐	See 'monitoring'. Discuss with senior if not falling or unexpected hypo.
Establish plan to check serum K+ 2 hrs after starting insulin/fluids.	☐	☐	See 'monitoring'. Discuss with senior if K+ < 3.5 or greater than 5.0 mmol/l.
Establish a monitoring plan for 4-hourly U&E, PO_4^{3-}, eGFR, capillary blood ketone (meter) and venous pH.	☐	☐	See 'monitoring'. Discuss any abnormal results with senior.

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Section 2 - Ongoing Management

Ongoing Management & actions	Y	N	Notes (If N for any answer, record comments in 'notes' section)
Record time of diagnosis of DKA = time of confirmatory bloods.	☐	☐	See 'diagnosis' & 'clinical'. Use ketone meter for blood ketone.
Start hourly treatment & monitoring record in **Section 3** below.	☐	☐	There should be an entry at least every hr. Time zero = start of insulin/fluids.
When BG is approximately 14 mmol/l halve insulin infusion.	☐	☐	Reduce IV insulin infusion to Humulin S (0.05 units/kg/hr).
When BG is approximately 14 mmol/l start IV Dextrose infusion.	☐	☐	At same time as IV insulin reduction, add IV 10% Dextose at 80 ml/hr.
Establish plan to adjust IV 10% Dextrose infusion to keep BG 6-12.	☐	☐	If BG < 4 mmol/l, give 100 ml IV 20% Dextrose bolus and increase IV 10% Dextrose infusion to 120 ml/hr; if BG 4-5.9 mmol/l, increase IV 10% Dextrose infusion to 120 ml/hr (without IV bolus); if BG > 12 mmol/l, reduce IV 10% Dextrose infusion to 40 ml/hr. Continue IV Humulin S (0.05 units/kg/hr) throughout and monitor BG and adjust IV 10% Dextrose further as required.
Continue IV saline 0.9% until fluid deficit resolved.	☐	☐	Use assessment of hydration: see 'fluids' but expect to give 3-5 litres total.
Continue to monitor K+.	☐	☐	If <3.5 or > 5.0, contact senior immediately to supervise K+ management.
Resolution			
Once well & resolution criteria met, transition to S/C insulin	☐	☐	See 'return to S/C insulin'
Assess for complications and refer to diabetes specialist nurse	☐	☐	See 'aftercare'

If at any stage, you are unsure how to interpret a result, what to do, or how to manage the patient – contact a senior without delay.
If any box in Section 2 is left unticked, you have deviated from the advised treatment plan and must document why in Section 4 below.

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This is not a prescription – you must still prescribe on Kardex or electronic system

Section 3: IV fluids & insulin monitoring:

Time of Initial Assessment _____ **(24 hr. clock)** **Date:** _____ **Time of Diagnosis of DKA** _____ **(24 hr. clock)** **Date:** _____

Time IV fluids started _____ **(24 hr. clock)** **Date:** _____ **Time IV insulin started** _____ **(24 hr. clock)** **Date:** _____

Date	Time (24 hr)	BG (mM)	Blood Ketone (mM)	K+ (mM)		IV Fluids (Name)	Infusion rate (ml/hr)	Fluids Start time (24 hr)	Fluids End time / changed (24 hr)		Insulin Rx (Method)	Start time	End time	Infusion rate	Brief Comments	Printed Name
e.g. *X/Y/ZZ*	*e.g.* *22.35*	*e.g.* *25.4*	*e.g.* *3.2*	*e.g.* *4.5*		*e.g.* *0.9% NaCl + XX mmol KCL*	*e.g.* *500 ml/hr*	*e.g.* *23.00*	*e.g.* *00.30*		*e.g.* *IV or S/C.*	*e.g.* *23.00*	*e.g.* *07.00*	*e.g.* *7.0 units/ hr*	*e.g. Referred to ICU*	*e.g. Fred Bloggs*

MWL Adult Diabetic Ketoacidosis (DKA) Management Chart V10c (Whiston & St Helens Hospitals, Nov 2024). Page 9 of 11

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Date	Time (24 hr)	BG (mM)	Blood Ketone (mM)	K+ (mM)		IV Fluids (Name)	Infusion rate (ml/hr)	Fluids Start time (24 hr)	Fluids End time / changed (24 hr)		Insulin Rx (Method)	Start time	End time	Infusion rate	Brief Comments	Printed Name
e.g. *X/Y/ZZ*	*e.g.* *22.35*	*e.g.* *25.4*	*e.g.* *3.2*	*e.g.* *4.5*		*e.g.* *0.9% NaCl + XX mmol KCL*	*e.g.* *500 ml/hr*	*e.g.* *23.00*	*e.g.* *00.30*		*e.g.* *IV or S/C.*	*e.g.* *23.00*	*e.g.* *07.00*	*e.g.* *7.0 units/ hr*	*e.g. Referred to ICU*	*e.g. Fred Bloggs*

MWL Adult Diabetic Ketoacidosis (DKA) Management Chart V10c (Whiston & St Helens Hospitals, Nov 2024). Page 10 of 11

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Date	Time (24 hr)	BG (mM)	Blood Ketone (mM)	K+ (mM)		IV Fluids (Name)	Infusion rate (ml/hr)	Fluids Start time (24 hr)	Fluids End time / changed (24 hr)		Insulin Rx (Method)	Start time	End time	Infusion rate	Brief Comments	Printed Name
e.g. *X/Y/ZZ*	*e.g.* *22.35*	*e.g.* *25.4*	*e.g.* *3.2*	*e.g.* *4.5*		*e.g.* *0.9% NaCl + XX mmol KCL*	*e.g.* *500 ml/hr*	*e.g.* *23.00*	*e.g.* *00.30*		*e.g.* *IV or S/C.*	*e.g.* *23.00*	*e.g.* *07.00*	*e.g.* *7.0 units/ hr*	*e.g. Referred to ICU*	*e.g. Fred Bloggs*

(Copy further pages of this table, if management continues beyond 24 hours and insert here, over-numbering the pages '10a of 11', '10b of 11'…etc)

MWL Adult Diabetic Ketoacidosis (DKA) Management Chart V10c (Whiston & St Helens Hospitals, Nov 2024). Page 11 of 11	Apply patient ID label
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Section 4 - Additional comments and blood monitoring results not recorded in Section 3

(please ensure that you enter date, time, signature & printed name with comment)