Worcestershire Acute Hospitals NHS Trust

GUIDELINES FOR THE TREATMENT OF DIABETIC KETOACIDOSIS (to be used in conjunction with DKA prescription and monitoring chart)

This guidance does not override the individual responsibility of health professionals to make appropriate decision according to the circumstances of the individual patient in consultation with the patient and /or carer. Health care professionals must be prepared to justify any deviation from this guidance.

Introduction

Diabetic Ketoacidosis (DKA) is a life threatening complication of Type 1 Diabetes. The 1999 British Diabetic Association (BDA) Cohort Study on Type 1 Diabetes concluded that the biggest cause of diabetes related deaths in the young adults was DKA. Patients with Type 2 diabetes can also develop DKA; the initial treatment is the same.

This guideline is for the treatment of patients aged 17 years and over with confirmed DKA. For guidance on managing DKA in children and adolescents please refer to WAHT –PAE-037 via the trust intranet.

This guideline is for use by the following staff groups :

Registered practitioners who are able to:

•Assess the health related needs of patients admitted with suspected or confirmed DKA.
•Assess, diagnose and treat patients with DKA in accordance to agreed nursing/medical guidelines.
•Initiate and contribute to the DKA Care Pathway which is designed to promote and improve standards of care for patients admitted with DKA.
•Provide accurate data to ensure care is delivered to a high standard.
•Work in collaboration with the multidisciplinary team so that continuity and consistency of care is being delivered to a high standard.
•Undertake forms of audit review on a regular basis

Lead Clinician(s)

Alison Hall	Lead Nurse Diabetes
Approved by Specialty Medicine Divisional Management Board on:	3RD April 2020
Approved by Medicines Safety Committee on:	9th September 2020
Review Date: This is the most current document and should be used until a revised version is in place	9th September 2023

Key amendments to this guideline

Date	Amendment	Approved by:
March 2015	Guideline updated to include latest advice and information as per National guidelines from Joint British Diabetes Societies Inpatient Care Group.	Diabetes Directorate
March 2015	Development of DKA prescription and monitoring chart (WR4922) to accompany DKA guideline.	Diabetes Directorate
April 2017	Advice given re: type 2 diabetes patients and SGLT2 and possibility of DKA.	Diabetes Directorate
December 2017	Sentence added in at the request of the Coroner	Diabetes Directorate
June 2020	1. Removal of Ward 1 at the Alex for paediatric support. 2.Change bleep number for DSN at the Alexandra Hospital 3. Add line to ensure action is taken if ketone reduction is below the desired rate.	Diabetes Directorate

These Guidelines are based on accepted good practice; references are available where research has been carried out to support practice.

1. Confirmation of Diagnosis of DKA

1.1 The presence of any 3 of the following (record results on DKA prescription and monitoring chart):

a) Significant ketonuria (++ or greater) or capillary ketones >3.0mmol/L

b) Bicarbonate less than 15.0mmol/l.

c) pH less than 7.3.

d) Blood glucose >11.0mmol/L

Ketoacidosis can occasionally occur even when plasma glucose is only mildly elevated; it should be excluded by blood gas analysis, not by blood glucose alone.

Significant hyperglycaemia in the absence of acidosis may indicate hyperglycaemic hyperosmolar state (HHS) and is also a diabetes emergency (*See WAHT-END-008)*

All patients should be reviewed by a consultant physician and considered for referral to the critical care team if patient is exhibiting signs of severe DKA.

1.2 Signs of severe DKA

- Blood ketones over 6 mmol/L
- Bicarbonate below 5 mmol/L
- pH less than 7.0
- GCS less than 12/15
- Systolic BP below 90 mmHg and/or pulse over 100 or below 60 bpm despite fluid replacement as advised in **Initial treatment: 0 to 60 minutes**.

If the patient is nursed in a non-Level 2/HDU environment critical care outreach nurses or those with appropriate experience should lead on nursing care.

2. Initial Treatment: 0 to 60 minutes

2.1 History

- Has the patient been diagnosed with diabetes previously, what type of insulin they take and the usual dose?
  - When they last took the insulin and how much they took.
  - Any missed insulin doses
  - Past medical history and treatment.
  - Has patient been previously admitted with DKA?
  - History of vomiting
  - Last menstrual period and possibility of pregnancy

- Consider possibility of DKA in patients with type 2 diabetes and blood glucose within normal parameters on SGLT2 inhibitors (Dapagliflozin, Empagliflozin, Canagliflozin).

2.2 Physical examination

- Assess for volume depletion (consider central venous pressure line)
- Assess for signs of infection (include foot examination)
- Assess for signs of myocardial infarction (consider silent M.I.)
- Assess for signs of concurrent illness.

2.3 Observations and bedside tests

- Pulse and blood pressure.
- Temperature
- Respiratory rate and pulse oximetry
- Glasgow coma scale (GCS)
- Capillary blood glucose (and ketones if available)
- Perform 12 lead ECG and commence cardiac monitoring.
- Urinalysis to check for ketones and infection, if leukocytes or nitrites present send MSU for culture.
- Commence hourly fluid balance chart/recording.

2.4 Establish large bore IV access x 2

2.5 Investigations

The following blood tests need to be taken and processed as lab emergency samples.

- Full Blood Count, HbA1c
- Creatinine and electrolytes, amylase, glucose
- Arterial blood gases

Consider:

- CXR
- Blood Cultures
- Cardiac enzymes
- Nasogastric tube if drowsy
- Urinary catheter
- Lumbar puncture

3. Treatment

Following an assessment of the level of dehydration the two early goals of treatment are fluid replacement and administration of insulin. Fluid replacement and administration of insulin should correct acidosis.

3.1 Fluid Replacement

If systolic BP on admission 90mmHg and over

- 0.9% Sodium Chloride 1 Litre over 60 minutes

Fluids should be prescribed on the DKA prescription and monitoring chart

If systolic BP on admission is lower than 90mmHg

Likely to be due to low circulating volume but consider other causes such as sepsis, heart failure.

Give 500mls 0.9% sodium chloride over 10-15 minutes, repeat if systolic BP remains less than 90mmHg.

If no improvement seek immediate senior review and involve ITU team.

Once systolic BP is greater than 90 mmHg continue with fluid regime as below.

Potassium replacement

Potassium level (mmol/L)	Potassium replacement mmol/L of infusion solution
>5.5	Nil
3.5-5.5	40 mmol/L
<3.5	40 mmol/L and seek Senior review for additional potassium required

Note: the maximum *concentration* of potassium which can be administered via peripheral line is 40mmol/L. The maximum *rate* of potassium infusion via peripheral line is 20mmol/hr. Aim to maintain serum potassium between 4 and 5mmo/L.

3.2 Commence a fixed rate intravenous insulin infusion (FRIII)

- Prepare an insulin infusion of 50 units human soluble insulin (Actrapid) made up to 50ml with 0.9% sodium chloride solution in a syringe pump.
- FRIII to be prescribed on the DKA monitoring and prescription chart (WR4922)
- Weigh patient or estimate in kilograms
- In pregnancy, use present weight.
- Infuse a fixed rate of 0.1 units/kg/hour (see table below)
- Give 0.1 units/kg human soluble insulin (i.e. Actrapid) by intramuscular injection **only** if unable to commence insulin infusion within 30 minutes.

- **If a patient normally takes long acting insulin (e.g. Insulatard, Humulin I, Glargine (Semglee /Abasaglar /Lantus), Detemir (Levemir), Degludec (Tresiba), Toujeo (u300) continue at the usual dose and time. Prescribe this insulin on the s/c insulin prescription chart (WR2169**) .

Administration of bicarbonate is **not** recommended. Fluid replacement and insulin should correct the acidosis.

Prescribe low molecular weight heparin for VTE prophylaxis as per Trust Guidance.

Commence treatment of concurrent illness if suspected

4. Continuing Treatment and monitoring: 60 minutes to 6 hours

Aims

- Clear ketones and suppress ketogenesis (reduce blood ketones by at least 0.5mmol/hr)
- Bicarbonate should rise by 3.0 mmol/L/hour
- Blood glucose should fall by 3.0mmol/L/hour
- Maintain serum potassium in the range of 4.0-5.0 mmol/l
- Avoid hypoglycaemia

4.1 Fluid Replacement

(FOR PATIENTS AGED 16-18 years USE FLUID REGIMEN IN PAEDIATRIC DKA PROTOCOL ref. WAHT-PAE-037 section D1)
Contact on call paediatric registrar/consultant on Riverbank ward (WRH) for advice if needed.

0.9% sodium chloride 1L with potassium chloride over next 2 hours
0.9% sodium chloride 1L with potassium chloride over next 2 hours
0.9% sodium chloride 1L with potassium chloride over next 4 hours
0.9% sodium chloride 1L with potassium chloride over next 4 hours
0.9% sodium chloride 1L with potassium chloride over next 6 hours

Fluids should be prescribed on the DKA prescription and monitoring chart
Reassessment of fluid status at 12 hours is required.

4.2 Monitoring (record results on DKA prescription and monitoring chart)

Check hourly capillary blood ketones if meter available
Check hourly capillary blood glucose (if meter reads “Hi” check venous blood glucose in blood gas analyser until glucose within the meter’s range)

Venous blood gas for pH, bicarbonate and potassium at 60 minutes, 2 hours and 2 hourly thereafter

If potassium is outside normal range, re-assess potassium replacement and check hourly. If abnormal after a further hour seek immediate senior medical advice.

**If acidosis is not resolving at the rate required increase the insulin infusion rate by 1 unit/hour increments hourly. This should also be done if the blood glucose is not falling at the desired rate of 3 mmol/L/hour and/ or if ketones are not reducing at the desired rate of 0.5mmol/l per hour. Ensure pump and lines are working correctly.

If glucose is less than 7 mmol decrease the rate by 1 unit/hour.

Continue the FRIII until capillary ketones <0.6mmol/L (if available), and/or venous pH>7.3 and venous bicarbonate >18.0mmol/L **(i.e. resolved DKA)**

When blood glucose falls below 14.0mmmol/L commence 10% glucose at rate of 125ml/hr via Y connector to the same cannula as the FRIII, this is prescribed as accompanying fluid to prevent hypoglycaemia.

0.9% sodium chloride to continue as per earlier guidance for fluid replacement/resuscitation

If persistent severe hypernatraemia consider substituting 0.9% sodium chloride with 0.45% sodium chloride.

5. On-going care: 6 to 24 hours

Aims

- Ensure clinical and biochemical parameters are improving
- Continue IV fluid replacement
- Continue insulin
- Assess for complications of treatment e.g. fluid overload (risk of cerebral oedema higher in patients less than 25 years old)
- Continue to treat precipitating causes
- Avoid hypoglycaemia

At 6 and 12 hours check venous pH, bicarbonate, potassium, blood ketones (if available) and glucose

If DKA not resolving at 6 hours return to **(above), if not resolving at 12 hours seek senior specialist advice.

When the acidosis has resolved, transfer from HDU can be arranged to a ward that specialises in caring for patients with diabetes.

5.1 Resolving DKA

If **DKA resolving** at either 6 or 12 hours and

a) Patient not eating and drinking

Move to continuous variable rate intravenous insulin infusion (CVRIII) and decrease accompanying 10% glucose infusion rate to 40ml/hour. Use CVRIII prescription and monitoring chart for infusion and accompanying fluid.

Continue IV fluid replacement with 0.9% normal saline with potassium chloride replacement levels if needed, continue to prescribe on the DKA prescription and monitoring chart.

b) Patient eating and drinking

Convert to subcutaneous insulin regime if eating and drinking and discontinue IV fluids. Prescribe on subcutaneous insulin prescription and monitoring chart.

Refer to diabetes specialist team as soon as possible

- The FRIII/CVRIII should be continued for 30 minutes after the initial subcutaneous dose of rapid-acting insulin (or 60 minutes if a basal insulin given). If biphasic insulin given or insulin pump therapy restarted wait 30 mins before discontinuing IV insulin.

5.2 Referrals

- If this episode of DKA is a first presentation of Type 1 diabetes the patient should be transferred onto the Care pathway for Management of Initiation of Insulin *(CP-END-001)* and should receive the Diabetes Kit including First Steps for Starting Insulin booklet (which includes the countywide DSN contact details).
- Referral to the diabetes team is essential and should be done at the earliest opportunity.

  Referrals should be made to the following:
  a) Diabetes Specialist Nurse* WRH bleep 315, Alexandra Hospital bleep 1030
  b) Consultant diabetologist or diabetes registrar
  c) Dietician
- The Diabetologist should take over care on the next working day.
- If a patient is ready for discharge before a diabetologist is available to review (e.g. over a weekend) the patient can be referred and seen as an outpatient.
- The Diabetes Specialist Nurse will review patients on the ward wherever possible. Follow up by a member of the diabetes nursing team after discharge is essential.

*Messages can also be left for diabetes specialist nurse on answer phone.

- A member of the diabetes team (Doctor or Nurse) should see all patients prior to discharge.

5.3 Provide copy of the following leaflet:

- Diabetes – When you are ill. (Available on wards and via Diabetes Specialist Nurse).

5.4Criteria for Discharge

- Metabolically stable (see **resolved DKA**) and clinically well
- Established on subcutaneous insulin regime and self-administering doses
- No vomiting within 24 hours
- Eating and drinking
- Capillary blood glucose less than 14 mmol/l
- Seen by a member of the Diabetes Specialist Team
- Has own capillary blood glucose meter and monitoring capillary blood glucose effectively
- Able to use Ketostix or blood ketone monitoring effectively
- Information leaflets given

- Appointment made for follow-up – Diabetes Specialist Nurse and Diabetologist
- Discharge letter completed for GP

Monitoring Tool

This should include realistic goals, timeframes and measurable outcomes.

How will monitoring be carried out?

Who will monitor compliance with the guideline?

Page/ Section of Key Document	Key control:	Checks to be carried out to confirm compliance with the policy:	How often the check will be carried out:	Responsible for carrying out the check:	Results of check reported to: *(Responsible for also ensuring actions are developed to address any areas of non-compliance)*	Frequency of reporting:
	WHAT?	**HOW?**	**WHEN?**	**WHO?**	**WHERE?**	**WHEN?**
Pages 3-9	Blood glucose rate reduction 3.0 mmol/hr	Audit	annually	Diabetes Directorate	Diabetes Directorate members 3-monthly meetings & Diabetes Consultants (trustwide)	Annually
Pages 3-9	Urine ketones or capillary ketones monitoring as per guideline & monitoring chart	Audit	annually	Diabetes Directorate	Diabetes Directorate members 3-monthly meetings & Diabetes Consultants (trustwide)	Annually
Page 6	Basal subcutaneous insulin continued with fixed rate IV insulin infusion	Audit	annually	Diabetes Directorate	Diabetes Directorate members 3-monthly meetings & Diabetes	Annually
Page 5	Commencement of fixed rate IV insulin infusion (FRIII) occurred within 0-60 minutes	Audit	annually	Diabetes Directorate	Diabetes Directorate members 3-monthly meetings & Diabetes Consultants (trustwide)	Annually
Page 5	Commencement of IV fluids according to protocol occurred within 0-60 minutes	Audit	annually	Diabetes Directorate	Diabetes Directorate members 3-monthly meetings & Diabetes Consultants (trustwide)	Annually
Page 9	Patient admitted into hospital with diabetic ketoacidosis receive	Audit	annually	Diabetes	Diabetes Directorate	Annually

	follow-up by the Diabetes Specialist team			Directorate	members 3-monthly meetings & Diabetes Consultants (trustwide)	

References

1. Joint British Diabetes Societies Inpatient Care Group (JBDS) (2013).'*The Management of Diabetic Ketoacidosis in Adults'.* 2nd Edition, September 2013.
2. Innes, E. Raafat, L. Perrin, T. ed. (2000). *Care of Diabetic Ketoacidosis.* Clinical Audit and Effectiveness Department, WRI, NHS TRUST.
3. Savage MW, Kilvert A. ABCD guidelines for the management of hyperglycaemic emergencies in adults. Practical Diabetes International 2006 (June); 23:227-231
4. BSPED recommended DKA guidelines 2009 www.bsped.org.uk
5. The British Diabetic Association (1996). *Diabetes in the UK*. 1996.
6. University Hospitals of Leicester NHS Trust Inpatient Diabetes Steering Group (2011). *Guidelines for the Management of Diabetic Ketoacidosis (DKA) in Adults*. Published December 2011. Accessed via internet on: 07.09.14.
7. Gloucestershire Royal Hospital NHS Trust (2012). *Guidelines for the Emergency Management of Diabetic Ketoacidosis.* Published January 2012. Accessed via internet on:07.09.14.
8. Injectable Medicines Guideline (*potassium chloride injection*) Published: 25/04/12) (Accessed on: 07/09/14). Available from: www.injguide.nhs.uk.
9. Joint Formulary Committee (2010). *British National Formulary*. 67th Edition. London, Royal Pharmaceutical Society of Great Britain.
10. Longmore et al (2007). *Oxford Handbook of Clinical Medicine*. 7th Edition. Oxford University Press.
11. Worcestershire Acute NHS Hospitals Trust (WAHT) (2010). *Handbook of Pathology*. Accessed via trust intranet on 07/09/14.

CONTRIBUTION LIST

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Clinical Speciality Lead	A & E

Circulated to the following Trust Committee for approval

Name	Trust Committee
	Medicines Safety Committee

Supporting Document 1 - Equality Impact Assessment Tool

. To be completed by the key document author and included as an appendix to key document when submitted to the appropriate committee for consideration and approval.

Please complete assessment form on next page;

Herefordshire & Worcestershire STP - Equality Impact Assessment (EIA) Form
Please read EIA guidelines when completing this form

Section 1 - Name of Organisation (please tick)

Herefordshire & Worcestershire STP		Herefordshire Council		Herefordshire CCG	
Worcestershire Acute Hospitals NHS Trust	X	Worcestershire County Council		Worcestershire CCGs	
Worcestershire Health and Care NHS Trust		Wye Valley NHS Trust		Other (please state)	

Name of Lead for Activity	**Alison Hall**

Details of individuals completing this assessment	**Name**	**Job title**	**e-mail contact**
	Alison Hall	**Lead Nurse Diabetes**	**Alison.hall24@nhs.net**
Date assessment completed	**03/08/2020**		

Section 2

Activity being assessed (e.g. policy/procedure, document, service redesign, policy, strategy etc.)	**Title: GUIDELINES FOR THE TREATMENT OF DIABETIC KETOACIDOSIS**				
What is the aim, purpose and/or intended outcomes of this Activity?	To provide safe and consistent guidance to managing this condition with the aim of supporting early resolution.				
Who will be affected by the development & implementation of this activity?	❑ ☑ ❑ ❑	Service User Patient Carers Visitors	☑ ❑ ❑ ❑	Staff Communities Other _____	
Is this:	☑ Review of an existing activity ❑ New activity ❑ Planning to withdraw or reduce a service, activity or presence?				
What information and evidence have you reviewed to help inform this assessment? (Please name sources, eg demographic information for patients / services / staff groups affected, complaints etc.	There are around 35,000 with diabetes living in Worcestershire. Approximately 7-10 % of people living with diabetes have Type 1 diabetes. People with type 1 diabetes are more likely to develop Diabetic Ketoacidosis than people with Type 2 diabetes. In the past few years there has been an increase in people with Type 2 diabetes developing DKA associated with treatment with SGLT2i medication.				

Summary of engagement or consultation undertaken (e.g. who and how have you engaged with, or why do you believe this is not required)	This Guideline has been developed from the JBS guidance on managing Diabetic Ketoacidosis and NICE guidelines for the management of Type 1 diabetes. It has been developed by hospital based healthcare professionals as this is where DKA should be treated. The National Diabetes Inpatient audit seeks to find out how people with diabetes feel about the care they receive in hospital
Summary of relevant findings	DKA can affect men and women of all ages. A new diagnosis of type 1 diabetes is more likely under the age of 40 years however a diagnosis can occur at any age. For those with pre-existing diabetes it is more typical for a young person under the age of 25 years to be admitted to hospital with DKA but age alone is not a factor for developing DKA. The guideline for the treatment of DKA in children and adults is different and therefore there is separate guidance for children.

Section 3

Please consider the potential impact of this activity (during development & implementation) on each of the equality groups outlined below. **Please tick one or more impact box below for each Equality Group and explain your rationale**. Please note it is possible for the potential impact to be both positive and negative within the same equality group and this should be recorded. Remember to consider the impact on e.g. staff, public, patients, carers etc. in these equality groups.

Equality Group	Potential positive impact	Potential neutral impact	Potential negative impact	Please explain your reasons for any potential positive, neutral or negative impact identified
Age		X		
Disability		X		
Gender Reassignment		X		
Marriage & Civil Partnerships		X		
Pregnancy & Maternity		X		
Race including Traveling Communities		X		
Religion & Belief		X		
Sex		X		
Sexual Orientation		X		

Equality Group	Potential positive impact	Potential neutral impact	Potential negative impact	Please explain your reasons for any potential positive, neutral or negative impact identified
Other Vulnerable and Disadvantaged Groups (e.g. carers; care leavers; homeless; Social/Economic deprivation, travelling communities etc.)		X		
Health Inequalities (any preventable, unfair & unjust differences in health status between groups, populations or individuals that arise from the unequal distribution of social, environmental & economic conditions within societies)		X		

Section 4

What actions will you take to mitigate any potential negative impacts?	Risk identified	Actions required to reduce / eliminate negative impact	Who will lead on the action?	Timeframe
		.		
How will you monitor these actions?				
When will you review this EIA? (e.g in a service redesign, this EIA should be revisited regularly throughout the design & implementation)	**When any changes to the guideline are required. When the guideline is due for review. If any evidence of discrimination due to the guidance emerges.**			

Section 5 - Please read and agree to the following Equality Statement

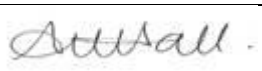
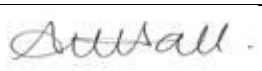
1. Equality Statement

1.1. All public bodies have a statutory duty under the Equality Act 2010 to set out arrangements to assess and consult on how their policies and functions impact on the 9 protected characteristics: Age; Disability; Gender Reassignment; Marriage & Civil Partnership; Pregnancy & Maternity; Race; Religion & Belief; Sex; Sexual Orientation

1.2. Our Organisations will challenge discrimination, promote equality, respect human rights, and aims to design and implement services, policies and measures that meet the diverse needs of our service, and population, ensuring that none are placed at a disadvantage over others.

1.3. All staff are expected to deliver services and provide services and care in a manner which respects the individuality of service users, patients, carer's etc, and as such treat

them and members of the workforce respectfully, paying due regard to the 9 protected characteristics.

Signature of person completing EIA	
Date signed	03/08/2020
Comments:	
Signature of person the Leader Person for this activity	
Date signed	03/08/2020
Comments:	

Supporting Document 2 – Financial Impact Assessment

To be completed by the key document author and attached to key document when submitted to the appropriate committee for consideration and approval.

	Title of document:	Yes/No
1.	Does the implementation of this document require any additional Capital resources	No
2.	Does the implementation of this document require additional revenue	No
3.	Does the implementation of this document require additional manpower	No
4.	Does the implementation of this document release any manpower costs through a change in practice	No
5.	Are there additional staff training costs associated with implementing this document which cannot be delivered through current training programmes or allocated training times for staff	No
	Other comments:	

If the response to any of the above is yes, please complete a business case and which is signed by your Finance Manager and Directorate Manager for consideration by the Accountable Director before progressing to the relevant committee for approval.