Worcestershire Acute Hospitals NHS Trust

Management of Hyperglycaemic Hyperosmolar state in Adults (HHS)

(Adopted from Joint British Diabetes Society Document on HHS)

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

This guideline is for the treatment of patients aged 18 years and over with confirmed HHS

THIS GUIDELINE IS FOR USE BY STAFF GROUPS WHO HAVE THE ABILITY TO:

- Assess the health related needs of patients admitted with suspected or confirmed HHS.
- Assess, diagnose and treat patients with HHS in accordance to agreed nursing/medical guidelines.
- Work in collaboration with the multidisciplinary team so that continuity and consistency of care is being delivered to a high standard.

Lead Clinician(s)

Dr Irfan Baber	Consultant Physician & Endocrinologist
Helen Payton	Pharmacist
Sarah Stroud	Diabetes Specialist Nurse

Approved by Diabetes Directorate on:	30th September 2020
Approved Speciality Medical Directorate on:	6th October 2020
Approved by Medicines Safety Committee on:	14th October 2020
Review Date: This is the most current document and should be used until a revised version is in place	14th October 2023

Worcestershire Acute Hospitals NHS Trust

Key amendments to this guideline

Date	Amendment	By:
11/07/11	Title: Management of Hyperosmolar Non-Ketotic State (HONK)/ Hyperglycaemic Hyperosmolar State (HHS).	D. Jenkins
11/07/11	Change of mortality figure from 50% to 10%	D. Jenkins
November 2016	Documents extended for 12 months as per TMC paper approved on 22nd July 2015	TMC
November 2017	Document extended whilst under review	TLG
December 2017	Sentence added in at the request of the Coroner	
December 2017	Document extended for 3 months as per TLG recommendation	TLG
March 2018	Document extended for 3 months as approved by TLG	TLG
June 2018	Document extended for 3 months as approved by TLG	TLG
June 2019	Document extended for 6 months whilst review and approval process	Alison Hall
30/02/2019	Complete rewrite of guideline	Diabetes directorate

Management of Hyperglycaemic Hyperosmolar state in Adults (HHS)

(Adopted from Joint British Diabetes Society Document on HHS)

Introduction

The hyperglycaemic hyperosmolar state (HHS) is a medical emergency. HHS is different from diabetic ketoacidosis (DKA) and treatment requires a different approach. The treatment differs as the population commonly affected by HHS is frequently elderly with multiple co-morbidities.

- It has a higher mortality than DKA
- DKA presents within hours of onset, HHS comes on over many days, and consequently the dehydration and metabolic disturbances are more extreme.

Definition and diagnosis

- Up to one third of patients who present with HHS do not have a previous history of diabetes.
- No definitive diagnostic criteria exists for HHS, but a few characteristics are prevalent

Features of HHS

- **Hypovolaemia**
- **Marked hyperglycaemia (>30 mmol/L)**
- **Absence of significant hyperketonaemia (<3.0 mmo/L Or acidosis (pH>7.3, bicarbonate >15 mmol/L)**
- **Osmolality >320 mosmol/kg (2xNa + Glucose + Urea)**

N.B. A mixed picture of HHS and DKA may occur.

Clinical assessment and management

On admission assess patient, document following and please initiate management immediately without delay. Consider managing patients in MHDU/ITU for high risk patients. The diabetes specialist team should be involved as soon as possible after admission.

- Pulse, BP, Temp, RR, O2 Sats, GCS
- Full clinical examination.
- Capillary blood glucose, blood ketones, venous pH, venous bicarbonate, lactate
- Plasma glucose, U/E, FBC, CRP

- Septic screen (where indicated) - Urinalysis and culture, Blood culture and CXR, ECG

High-dependency / level 2 care

Patients with HHS are complex and often have multiple co-morbidities so require intensive monitoring.

The presence of one or more of the following may indicate the need for admission to a high-dependency unit / level 2, where the insertion of a central venous catheter to aid assessment of fluid status and immediate senior review by a clinician skilled in the management of HHS should be considered:

- Osmolality > 350 mosmol/kg
- Sodium > 160 mmol/l
- Hypokalaemia (< 3.5 mmol/l) or hyperkalaemia (> 6 mmol/l) on admission
- Glasgow Coma Scale < 12 or Abnormal AVPU (Alert, Voice, Pain, Unresponsive) scale
- Oxygen saturation < 92% on air (assuming normal baseline respiratory function)
- Systolic blood pressure below 90 mmHg
- Anticipated fluid balance difficulties
- Significant comorbidities eg MI
- Hypothermia
- PH <7.1
- HR > 100bpm or <60bpm
- Urine output < 0.5ml/kg/hr
- Serum creatinine > 200umol/L

Goals of treatment

The goals of treatment of HHS are to treat the underlying cause and to gradually and safely

- Normalise the osmolality
- Replace fluid and electrolyte losses
- Normalise blood glucose
- Prevent thrombosis , use prophylactic LMWH unless contraindicated
- Assess mental state at baseline
- Assess for neurological deterioration 1-2 hourly eg: cerebral oedema , osmotic demyelination
- Provide foot heel care and daily foot checks
- Patient should have continuous pulse oximetry and cardiac monitoring
- The mortality with HHS can be as high as 10-20% depending on the precipitating factors. It is therefore important to investigate the underlying cause such as sepsis, myocardial infarction, cerebrovascular accident, pancreatitis, mesenteric infarction etc.
- Seek early advice from the Diabetes Team

Fluid management

Most important initial therapeutic intervention is appropriate fluid replacement followed by insulin administration.

If SBP <90mmHg give 500 ml of 0.9% sodium chloride infusion over 10-15 minutes.
If SBP remains below 90mmHg this may be repeated.

If there has been no clinical improvement reconsider other causes of hypotension and seek **immediate senior assessment**. Consider involving the MHDU/Critical care team.

Once SBP is above 90mmHg follow fluid replacement as below

0.9% Sodium Chloride: 1 Litre over 1 hour
1 Litre over 2 hours
1 Litre over 2 hours
1 Litre over 4 hours
1 Litre over 6 hours until rehydrated

Aim for a positive fluid balance of 3-6 Litres by 12 hours and then continue gradual replacement over next 48 hours and aim for a

Fall in glucose ≤ 5mmol/L/hour

- Fall in calculated osmolality (2xNa + Glucose + Urea) of 3-8 mosm/kg/hour
- An initial rise in sodium is expected , this is only of concern if osmolality is not declining (**see treatment targets**)
- Sodium fall must be <10mmol/l per 24 hour

Adjust fluids as follow

Provided osmolality falling appropriately continue 0.9% Sodium Chloride (even if sodium [Na] is rising)

If osmolality increasing (or falling at rate < 3 mosml/kg/hour) and Sodium (Na) increasing check fluid balance.

- If inadequate ,increase rate of infusion of 0.9 % sodium chloride
- If adequate consider changing to 0.45 % sodium chloride at same rate

If osmolality is falling at rate > 8 mosmol/kg/hour

- Consider reducing rate of IV fluids
- Reduce rate of insulin infusion if already commenced

- When glucose falls below 14 mmol/l, commence 10% glucose given at 125ml/hr. **Continue 0.9% Sodium Chloride IV infusion alongside this** to correct circulatory volume (**Infuse 0.9% sodium chloride in separate cannula**). However, if there is concern regarding rapid or excessive fluid replacement, modify the rate as necessary.

- Monitor 1-2 hourly for fluid overload, cerebral oedema or osmotic demyelination (altered level of consciousness)

- Rapid correction of hypernatraemia or hyperglycaemia may lead to marked osmotic shifts with the rare complication of cerebral oedema. Cerebral oedema is a life threatening complication. If suspected exclude hypoglycaemia and consider CT brain and admission to MHDU.

- Care should be taken with fluid replacement in at-risk groups such as elderly, renal failure, congestive heart failure and ischaemic heart disease. Some patients need CVP monitoring

- **If blood glucose falls quickly (>6 mmol/l per hour) the hydration status should be reassessed and the rate of fluid and insulin infusion should be reduced.**

Insulin management

Blood glucose levels will fall consistently for the first few hours with fluid replacement alone

Insulin start time depends on the presence of ketones

Some ketones (> 1mmol/L or ++)

- Start intravenous fixed rate insulin infusion immediately
- Give IV insulin at 0.05 units/kg/hour (eg 60 kg = 3 units/hour)

No significant ketones (< 1mmol/L or +)

- Fluid replacement alone initially
- Once the fall in glucose is < 5 mmol/L/hour, reassess fluid intake and start IV insulin (0.05/kg/hour)

Patients usually need much **SMALLER** amounts of insulin and potassium than DKA patients

Avoid hypoglycaemia. Aim to keep blood glucose 10-15 mmol/L in first 24 hours.

If blood glucose falling less than 5 mmol/L per hour check fluid balance.

- If positive balance inadequate, increase rate of infusion of 0.9% sodium chloride
- If positive fluid balance adequate, commence low dose IV insulin (0.05 units/kg/hr) or if already running, increase rate to 0.1 units/kg/hr

Potassium replacement

Patients with HHS are generally potassium depleted, but acidosis is less common than in patients with DKA. Potassium shift is therefore less pronounced.

Use commercially prepared ready to use dilute infusions with added potassium wherever possible

Potassium level (mmol/L)	Potassium replacement per 1 litre infusion fluid
More than 5.5	Nil
3.5 – 5.5	40mmol
Less than 3.5	Senior review additional potassium may be needed (central Line)

Monitoring

- Monitor vital signs (NEWs score)
- Check Glucose, Urea, K+ and calculated osmolality hourly for the first 6 hours
- Change to 2 hourly after 6 hours if response satisfactory
- Keep a strict intake output chart
- Catheterisation usually required

All results should be entered into the monitoring chart and reviewed by a doctor regularly.

Treatment targets

Aim for following targets

- Fall in glucose $\leq$ 5mmol/L/hour
- Fall in calculated osmolality (2xNa + Glucose + Urea) of 3-8 mosm/kg/hour
- Sodium fall must be < 10mmol/L per 24 hour
- Aim for glucose 10- 15 mmol/L
- When glucose fall < 14 mmol/L start 10% glucose at 125 mls/hour

Anticoagulation therapy

Patients with HHS are at a high risk of developing venous thromboembolism.

All patients with HHS should receive prophylactic low molecular weight heparin for the full duration of admission unless contraindicated (please refer to Venous Thromboembolism Policy).

Recovery phase

- Transfer to subcutaneous insulin when eating and drinking normally, seek advice from diabetes specialist team
- Stop intravenous insulin infusion 1 hour after first subcutaneous intermediate or long acting insulin injection
- After discharge the initial outpatient follow up should be in secondary care.
- Ultimately transfer to diet and tablets may be possible depending on diabetes specialist team assessment

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?**
	These are the 'key' parts of the process that we are relying on to manage risk. We may not be able to monitor every part of the process, but we MUST monitor the key elements, otherwise we won't know whether we are keeping patients, visitors and/or staff safe.	What are we going to do to make sure the key parts of the process we have identified are being followed? (Some techniques to consider are; audits, spot-checks, analysis of incident trends, monitoring of attendance at training.)	Be realistic. Set achievable frequencies. Use terms such as '10 times a year' instead of 'monthly'.	Who is responsible for the check? Is it listed in the 'duties' section of the policy? Is it in the job description?	Who will receive the monitoring results? Where this is a committee the committee's specific responsibility for monitoring the process must be described within its terms of reference.	Use terms such as '10 times a year' instead of 'monthly'.
All	Adequate fluid replacement. Fluid balance recording. Monitoring of bloods and calculations of osmolality. Referral to specialist Diabetes team	Review of completion of monitoring chart completed for each episode of HHS	When HHS occurs	DSN Inpatient team	Diabetes Directorate and Specialty Medicine Division	Quarterly to Diabetes directorate and yearly to SpMed DMB

References

Scott, A., Claydon, A. (2012) *The management of the hyperosmolar hyperglycaemic state (HHS) in adults with diabetes* Joint British Diabetes Societies Inpatient Care Group

Contribution List

This key document has been circulated to the following individuals for consultation;

	Designation
Dr Irfan Barbar	Consultant Physician & Endocrinologist
Alison Hall	Lead Nurse for Diabetes
Susan Rogers	Diabetes Specialist Nurse
Hannah Webb	Diabetes Specialist Nurse
Marie Major	Diabetes Specialist Nurse
Jessica Stokes	Diabetes Specialist Nurse
Lisa Smith	Diabetes Specialist Nurse
Caroline Rolfe	Diabetes Specialist Nurse
Julie Reeley	Diabetes Specialist Nurse
Swapna George	Diabetes Specialist Nurse
Wendy Butters	Diabetes Specialist Nurse
Sara Molineaux	Diabetes Specialist Nurse

This key document has been circulated to the chair(s) of the following committee's / groups for comments;

Committee
Diabetes Directorate
Specialty Medicine Directorate

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;

Worcestershire Acute Hospitals NHS Trust

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

Name of Lead for Activity	**Irfan Babar**

Details of individuals completing this assessment	**Name**	**Job title**	**e-mail contact**
	Alison Hall	**Lead Nurse Diabetes**	**Alison.hall24@nhs.net**
Date assessment completed	**15/09/2020**		

Section 2

Activity being assessed (e.g. policy/procedure, document, service redesign, policy, strategy etc.)	**Title: management of inpatients with hyperosmolar hyperglycaemic State**

What is the aim, purpose and/or intended outcomes of this Activity?	Give safe and effective tretment				
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.	Nadia Hams Audit				
Summary of engagement or consultation undertaken (e.g. who and how have you engaged with, or why do you believe this is not required)	Diabetes Directorate / Urgent Care teams / Specialty Medicine Division				
Summary of relevant findings	Previous document our dated and needed complete overhaul as new guidance published.				

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		

Equality Group	Potential positive impact	Potential neutral impact	Potential negative impact	Please explain your reasons for any potential positive, neutral or negative impact identified
Sex		x		
Sexual Orientation		x		
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 guidance needs updating or new evident emerges nationally.**			

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

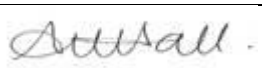
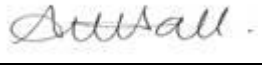
1. Equality Statement

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	15/09/2020
Comments:	
Signature of person the Leader Person for this activity	
Date signed	30/09/2020
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:	No

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.