

**Beth Israel Deaconess Medical Center
Joslin Diabetes Center and Joslin Clinic**

**Guideline for Management of
HYPERGLYCEMIC EMERGENCIES FOR ADULTS**

8/6/04

The Beth Israel Deaconess Medical Center/Joslin Diabetes Center Guideline for Management of Hyperglycemic Emergencies is designed to assist primary care and emergency department providers individualize the care of adult patients who present with hyperglycemia or diabetic ketoacidosis. This Guideline is not intended to replace sound medical judgment or clinical decision-making. Clinical judgment must determine the need for adaptation in all patient care situations; more or less stringent interventions may be necessary. This Guideline was developed and approved through the Joslin Clinical Oversight Committee that reports to the Chief Medical Officer of the Joslin Diabetes Center and Joslin Clinic.

Emergency Assessment

Assessment	<p><u>Assess:</u></p> <ul style="list-style-type: none"> ● Hemodynamic status: volume status/degree of dehydration/perfusion ● Vomiting and ability to take p.o. ● Diabetes history, medications and symptoms ● Diabetes-related complications ● Adherence to treatment plan ● Social & medical history (e.g. alcohol and drug use) ● Precipitating events leading to high plasma glucose (e.g. MI, omission of insulin, infection, CNS event) ● Pregnancy if clinically relevant ● Occult infection (e.g. skin, feet, UTI, cellulitis, sacral decubitus) ● Presence of ketonemia and acid-base disturbance
Specimens & Tests	<ul style="list-style-type: none"> ● Immediate finger-stick glucose ● If available, consider immediate finger-stick beta-hydroxybutyrate (β-OHB) if ketoacidosis is suspected ● Glucose (lab), CBC, Na, K, Cl, CO₂, BUN, creatinine levels ● U/A, check urine ketones; if positive or if unable to void, check serum ketones ● Calculated or measured serum osmolality and anion gap (see below) ● If considering osmotically active substance other than glucose, measured osmolar gap; consider tox screen ● Blood and/or urine cultures, when indicated ● Chest x-ray, when indicated ● Pregnancy test, if clinically relevant ● ABGs or VBGs if indicated by clinical findings (esp. metabolic or respiratory acidosis) ● EKG if diabetes > 10 years duration or type 2 with cardiovascular risk factors (need to monitor K⁺ status)
Diagnosis Based on Clinical Findings & Lab Results	<ul style="list-style-type: none"> ● Determination of diagnosis: <ul style="list-style-type: none"> - Hyperglycemia - Hyperglycemia with hyperosmolarity - Ketosis without acidosis - Diabetic ketoacidosis - Other acid-base disturbance (i.e. lactic acidosis, alcoholic acidosis)

CALCULATIONS

<i>Calculation of effective serum osmolality</i>	$2[\text{Na}^+ + \text{K}^+] + \frac{(\text{glucose in mg/dl})}{18} + \frac{\text{BUN}}{2.8}$
<i>Correction of serum sodium</i>	$[\text{Na}^+] + 1.6 \times \frac{(\text{glucose in mg/dl}) - 100}{100}$
<i>Calculation of the anion gap</i>	$[\text{Na}^+] - [\text{Cl} + \text{HCO}_3^-]$

HYPERGLYCEMIA

DEFINITION:

Hyperglycemia: plasma glucose > 250 mg/dl

ASSESSMENTS

- Determine if newly diagnosed vs. established diabetes
- Determine if type 1 vs. type 2
- Determine if hemodynamically stable
- Identify precipitating factors
- Assess volume status
- Assess ability to take p.o.

SPECIMENS AND TESTS

- Urinalysis including urine ketones (consider serum ketones if urine ketones positive or blood β -OHB level elevated)
- Na, K, Cl, CO₂, BUN and creatinine
- Other tests as indicated by clinical findings

ADMISSION STRATEGY

Consider admission if:

- | | | |
|--|---|---|
| <ul style="list-style-type: none"> ● Hemodynamically unstable ● Unable to take or maintain p.o. intake ● Unable and/or unlikely to initiate/attain self-management skills within 24 hours | <ul style="list-style-type: none"> ● BG > 400 mg/dl ● Newly diagnosed type 1 | <ul style="list-style-type: none"> ● Very low pH, low HCO₃ ● Other apparent medical/surgical reasons |
|--|---|---|

TREATMENT IN EMERGENCY DEPARTMENT

Type 1 New Stable	Type 1 Established Stable	Type 1 New or Established Unstable	Type 2 New Stable	Type 2 New or Established Unstable
<ul style="list-style-type: none"> ● Administer rapid-acting insulin stat (e.g., 10 units subQ or 0.1 unit/kg body wt) ● Consider IV fluids* ● Re-assess clinical condition in 2-4 hours ● Consider admission for observation & continuation of IV fluids & insulin ● Obtain consultation from Diabetologist/Endocrinologist ● Arrange for discharge once management plan is confirmed ● Provide written instructions 	<ul style="list-style-type: none"> ● Consider rapid-acting insulin stat (e.g., 10 units subQ or 0.1 unit/kg body wt) ● Consider IV fluids* ● Re-assess clinical condition in 2-4 hours ● Contact PCP or primary endocrinologist ● Arrange for discharge once management plan is confirmed ● Provide written instructions 	<ul style="list-style-type: none"> ● Refer to DKA guideline (pg 3) and admit 	<ul style="list-style-type: none"> ● Consider rapid-acting insulin stat (e.g., 10 units subQ or 0.1 unit/kg body wt) ● Consider IV fluids* ● Re-assess clinical condition in 2-4 hours ● Contact PCP re: discharge plans ● Provide written instructions 	<ul style="list-style-type: none"> ● Administer rapid-acting insulin stat (e.g., 10 units subQ or 0.1 unit/kg body wt) ● Start IV fluids* ● Re-assess clinical condition in 2-4 hours ● Consider admission for continuation of IV fluids and insulin; Is & Os ● Consider that, in the hyperosmolar state, the patient may need more fluid & less insulin than indicated in the DKA guideline (pg 3)

SUBSEQUENT INSULIN MANAGEMENT FOR TYPE 1 & INSULIN-REQUIRING TYPE 2

Stable Patients

(Call provider if BG < 60 mg/dl, if there are symptoms of hypoglycemia, or if BG > 400 mg/dl)

For Patients Taking P.O.

- Return to prior insulin regimen or re-evaluate dose if prior regimen inadequate (for patients previously receiving insulin)
- Administer 15 g carbohydrate & repeat BG 15 min. later if patient becomes hypoglycemic (BG < 80 mg/dl)

If Patient N.P.O.

- See Joslin Guideline: Inpatient Management of Surgical Patients with Diabetes, page 4

*SUGGESTIONS for FLUID MANAGEMENT

Infuse normal saline as indicated to maintain hemodynamic stability. One may need to adjust type & rate of fluid administration (e.g. use ½ NS) in the elderly and in patients with CHF or renal failure.

DIABETES SELF-MANAGEMENT EDUCATION

Educational Assessment

- If admitted, refer for inpatient teaching as early as possible
- Assess short-term learning needs/skills re: diabetes self-management
- Refer for outpatient ongoing diabetes self-management education:
 - within 1 week for newly diagnosed patients
 - within 2-3 weeks for established patients

Skills/Knowledge Needed

- Self-monitoring blood glucose (SMBG): actual frequency individualized, but recommend minimum of 2x/day
- Insulin administration if indicated
- Basic meal planning skills
- Sick day guidelines and hypoglycemia treatment strategies
- Emergency indicators and reasons to call M.D.

DISCHARGE PLANNING

- Assess ongoing and future medical and educational needs
- Arrange for home care as appropriate for patient
- Coordinate discharge follow-up with PCP or endocrinologist within 1-2 weeks

DIABETIC KETOACIDOSIS (DKA)**DEFINITION:**

Hyperglycemia (>200 mg/dl) with metabolic acidosis (pH <7.3) and an elevated anion gap (>12) with positive ketones*
***Ketoacidosis with blood glucose <200 mg/dl may occur, but consider other causes of metabolic acidosis.**

ASSESSMENT

- If diagnosis confirmed as DKA & insulin drip required, then admit
- Obtain consultation from Diabetologist/Endocrinologist
- Initiate patient education

SPECIMENS/TESTS

- Acute inpatient management:
- Electrolytes q 2 hours until sustained improvement x 4 hours
- Follow anion gap
- Fingerstick glucose every hour
- Recommend checking phosphate q 4 hrs; calcium & magnesium level at initiation
- Check urine ketones; DO NOT REPEAT if anion gap and bicarb are returning to normal
- Check EKG if $K^+ > 6.0$ mEq/l

SUGGESTED FLUID AMOUNTS

May need to adjust type & rate of fluid administration in the elderly and in patients with CHF or renal failure. KCL should be added to IV fluids once urination is established. If patient is severely hypovolemic or in shock, initiate fluid resuscitation before commencing insulin.

Administer NS as indicated to maintain hemodynamic status, then follow general guidelines:

- Administer NS for first 4 hours
- Then consider ½ NS x 4 hours
- Then D5/ ½ NS when plasma glucose <250 mg/dl

Hour	Volume
1 st ½ -1	1 Liter
2 nd hour	1 Liter
3 rd hour	500 ml-1Liter
4 th hour	500 ml-1Liter
5 th hour	500 ml-1Liter
Total 1 st 5 hours	3.5-5 Liters
6-12 th hours	250-500 ml/hr

INSULIN MANAGEMENT

- Aim for target plasma glucose between 100-200 mg/dl
- Administer Regular insulin 10 units IV STAT
- Start Regular insulin infusion at 5 units/hour or 0.1units/kg/hour
- Assess possible causes of lack of adequate decrease in plasma glucose
- Increase by 1 unit/hr q 1-2 hours if < 10% drop in glucose or no improvement in acid-base status
- Decrease insulin by 1-2 units/hr when glucose \leq 250 mg/dl and/or progressive improvement and anion gap closing
- DO NOT decrease insulin infusion to < 1 unit/hour
- If plasma glucose initially drops to < 100 mg/dl on insulin infusion, add glucose to IV as D5 or D10 at sufficient rate
- Check plasma glucose every 30 minutes if plasma glucose drops to < 100 mg/dl
- If plasma glucose continues to drop consistently on IV D5 consider change to IV D10 to maintain glucose at 100-200 mg/dl, while on insulin infusion
- Once patient can eat and anion gap is resolving, consider change to subQ insulin (continue IV insulin infusion for 1 hour after starting subQ insulin)
- For patients previously managed on insulin: re-evaluate insulin regimen before returning to prior dose
- For patients new to insulin: consider a regimen including a mixture of rapid- and long-acting insulin

POTASSIUM (use KCL)

Do not administer K: if $K > 5.5$ or if patient is anuric.

Serum K (mEq/l)	Additional K required
<3.5	40 mEq/L
3.5-4.4	20 mEq/L
4.5-5.5	10 mEq/L
>5.5	Stop infusion

If there is persistent acidosis due to hyperchloremia, consider using K phosphate or K acetate instead of KCL as replacement. Can consider oral K^+ replacement, as needed.

BICARBONATE

- If arterial pH < 7.0, consider giving 100 ml $NaHCO_3$ over 45 minutes
- Check acid-base 30 min. later & repeat if pH <7.0
- Bicarbonate should not be administered if K^+ is \leq 3.5

PHOSPHATE

Consider K phosphate if patient is hypophosphatemic. Oral replacement is preferred.

GENERAL MEASURES

- Consider Foley catheter
- Adequate IV access recommended for appropriate hydration/insulin administration. Rec. # 18 catheter or larger.
- Consider nasogastric tube (NGT) for gastric atony
- Consider anti-emetics if mental status allows

DIABETES SELF-MANAGEMENT EDUCATION

(refer to pg 2 Hyperglycemia Management)

- New patients: Recommend Diabetes/Endocrine Consult; refer to Diabetes Consult team if available
- Established patients: Contact PCP re: plan and/or referral

HYPEROSMOLAR HYPERGLYCEMIC STATE (HHS)

These states require similar management to the above, with the following exceptions:

- acidosis, if present may be due to other causes; consider checking lactic acid, tox screen, etc.
- more fluids may be required, as patients may be more dehydrated
- lower doses of insulin may be required as patients may be sensitive to insulin
- monitoring of the cardiovascular status in elderly is required especially if at risk for CHF and fluid overload

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Approved by the Joslin Clinical Oversight Committee 8/6/04.

Glossary			
ABGs:	arterial blood gasses	HHS:	hyperosmolar hyperglycemic state
BG:	blood glucose	NGT:	nasogastric tube
β-OHB:	beta-hydroxybutyrate	SMBG:	self-monitoring of blood glucose
DKA:	diabetic ketoacidosis	SubQ:	subcutaneously
HCO₃:	bicarbonate	VBGs:	venous blood gasses

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