

Diabetes In The Hospital

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Objectives

- Discuss guideline based diabetes care in a hospital setting
- Understand benefits and limitations of different diabetes medications in hospital care
- Learn how to implement these guideline based practices into clinical settings



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Guideline References

- American Diabetes Association
- American Association of Clinical Endocrinology



Recommendations: Diabetes Care in the Hospital

Diabetes discharge planning

- Start at hospital **admission**
- Clear diabetes management instructions should be provided at discharge



Recommendations: Diabetes Care in the Hospital

- All patients with diabetes admitted to the hospital should have their diabetes clearly identified in the medical record
(type 1? type 2?)
- Why does this matter? Medication indications



Recommendations: Diabetes Care in the Hospital Evaluating Hyperglycemia

- Consider obtaining an A1C in patients
 - With diabetes admitted to the hospital if testing result in previous 2–3 months unavailable
 - With risk factors for undiagnosed diabetes who exhibit hyperglycemia in the hospital
- Patients with hyperglycemia without a prior diagnosis: document plans for follow-up testing and care at discharge



Recommendations: Diabetes Care in the Hospital Goals for blood glucose levels

Critically ill patients

- Initiate insulin therapy for persistent hyperglycemia
 - starting **no greater than 180 mg/dL** (10 mmol/L); once started,
 - **glucose range of 140–180 mg/dL** (7.8–10 mmol/L) is recommended
- More stringent goals, 110–140 mg/dL (6.1–7.8 mmol/L) may be appropriate for selected patients if achievable without significant hypoglycemia
- Critically ill patients require an IV insulin protocol

ADA. 13. Diabetes Care in the Hospital, Nursing Home, and Skilled Nursing Facility. Diabetes Care 2015;38(suppl 1):S80



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Recommendations: Diabetes Care in the Hospital Goals for blood glucose levels

Non-Critically ill patients

- If treated with insulin,
 - premeal blood glucose targets of <140 mg/dL (7.8 mmol/L)
 - random blood glucose <180 mg/dL (10.0 mmol/L)
 - provided these targets can be safely achieved.
 - More stringent targets may be appropriate in stable patients with previous tight glycemic control.
 - Less stringent targets may be appropriate in some patients



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Recommendations: Diabetes Care in the Hospital Goals for blood glucose levels

Non-Critically Ill patients

- Basal plus correction insulin regimen preferred for patients with poor oral intake or NPO (this is NOT sliding scale) don't confuse correction insulin with sliding scale, they are not the same
- Basal, nutritional, and correction components is the preferred treatment for patients with good nutritional intake
- **Hypoglycemia management protocol should be adopted and implemented for all patients on insulin**



Standard Definition of Glucose Abnormalities

- Hyperglycemia **>140 mg/dl** (7.8 mmol/L).
- Alert level hypoglycemia **<70 mg/dL** (3.9 mmol/L)
- Severe hypoglycemia **<56 mg/dL** (3.1 mmol/L) (NEW 2017)
- Admission A1C value $\geq 6.5\%$ suggests pre-existing diabetes.



How Did We Get These Targets For Hospital Patients?



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Diabetes Care in the Hospital: NICE-SUGAR Study

- Largest randomized controlled trial to date
- Tested effect of tight glycemic control (target 81–108 mg/dL) on outcomes among 6,104 critically ill participants
- Majority (>95%) required mechanical ventilation



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Diabetes Care in the Hospital: NICE-SUGAR Study

- **In both surgical/medical patients**
 - 90-day mortality significantly higher in intensively treated (target 81–108 mg/dL) vs conventional group (target 144–180 mg/dL)
 - Severe hypoglycemia more common (6.8% vs. 0.5%; $P < 0.001$)
 - Findings strongly suggest may not be necessary to target blood glucose levels < 140 mg/dL
 - Highly stringent target of < 110 mg/dL may actually be dangerous



Special Circumstances

- **Enteral /Parenteral Feedings**
(NPH may be good for 8-12 hour feedings)
- **Diabetic ketoacidosis (DKA) and hyperosmolar hyperglycemic state (HHS)-** know protocols, insulin, fluids, potassium/electrolytes
- **Glucocorticoid Therapy** (depends on length of therapy)



Diabetic Ketoacidosis Hyperglycemic Hyperosmolar State

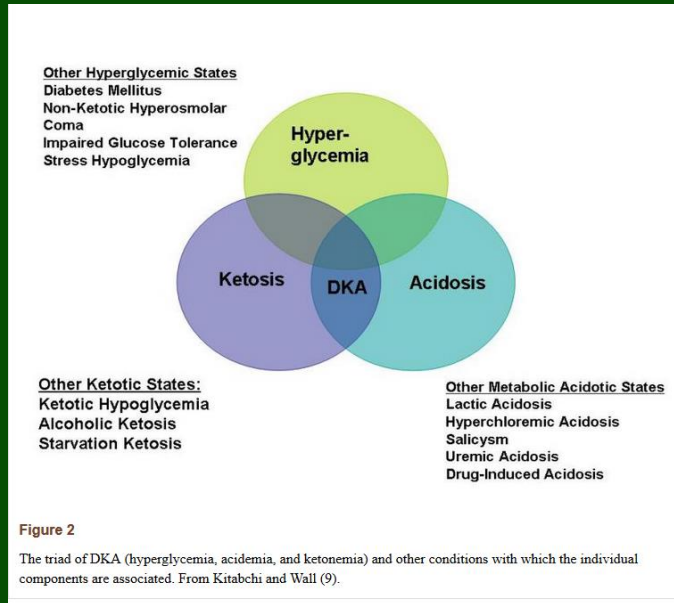
- Diabetic ketoacidosis (DKA) and hyperglycemic hyperosmolar state (HHS) are diabetic emergencies that can cause high morbidity and mortality (HHS>DKA)
- Recall that up to 20% of type 2 may have ketones
- Risk for ketoacidosis- new diagnosis, stop taking meds, infection



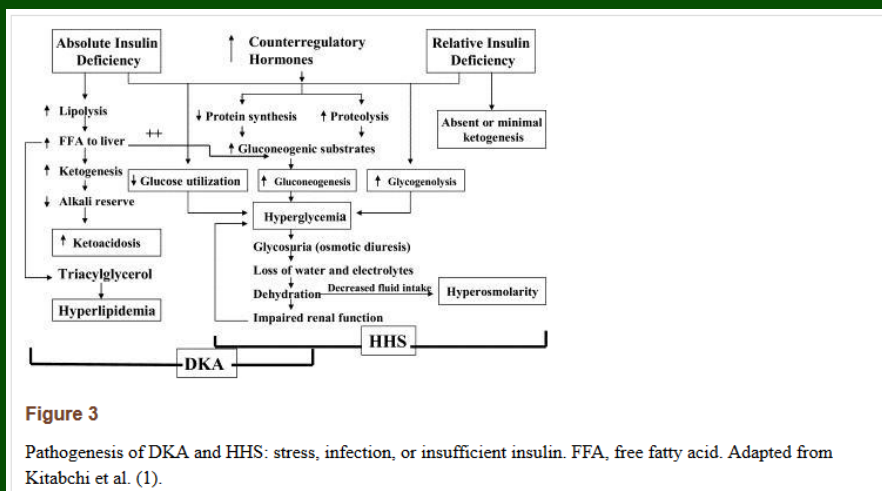
Common clinical presentation of DKA and HHS

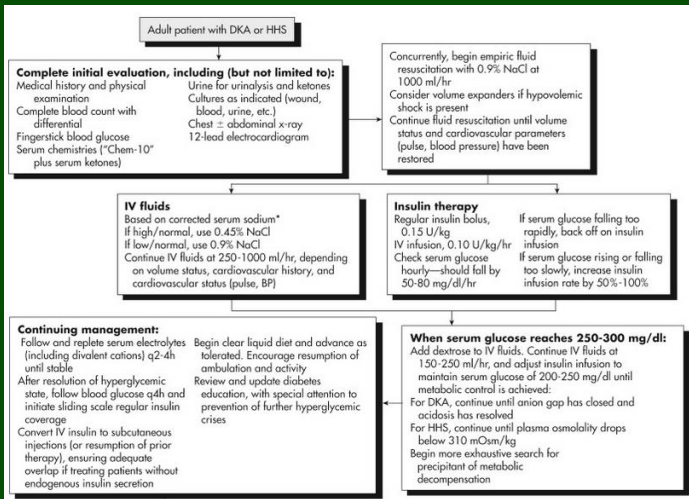
- Due to hyperglycemia and include polyuria, polyphagia, polydipsia, weight loss, weakness, and physical signs of dehydration such as dry buccal mucosa, sunken eye balls, poor skin turgor, tachycardia, hypotension and shock in severe cases
- Kussmaul respiration, acetone breath, nausea, vomiting and abdominal pain may also occur primarily in DKA
- Abdominal pain, which correlates with the severity of acidosis





Diabetic Ketoacidosis





- After target glucose levels are achieved, it usually takes 5 to 7 hr for ketosis to clear
- Lowering glucose too quickly can lead to cerebral edema and/or central pontine myolysis
- Consider usual factors with fluid replacement
- Potassium attention and replacement very important
- Bicarb only with very specific parameters

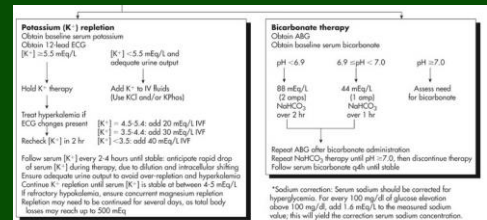


FIG. 1 Management of diabetic ketoacidosis (DKA) and hyperosmolar hyperglycemic state (HHS). ABG, Arterial blood gas; ECG, electrocardiograph. From Goldman L, Ausiello D [eds]. Cecil textbook of medicine, ed 23. Philadelphia, 2008. Saunders.

- In young children, hydration may play a big role in hyperglycemia resolution
- Insulin dose in young children 0.1 U/kg (maybe less)
- <https://www.mdcalc.com/sodium-correction-hyperglycemia>

Ferri's Clinical Advisor 2018, 386-388.e1; Endotext [Internet] accessed June 2017; JAMA. 2015;313(22):2274-2275



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Strange Normoglycemic Ketoacidosis

- SGLT-2 inhibitors
- Be aware, tell patients if not feeling well to seek treatment



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Insulin Protocols

- IV insulin infusion
- Use your hospital's protocols (EHR)
- When switching from IV infusion to subcutaneous, stop IV about 2 hours after subcutaneous start
- Be aware that long acting basal insulins may take awhile to achieve steady state



Perioperative Management

- AM of procedure: hold oral agents, half dose of insulin if NPH, **full dose if basal**
- Pump: usually management with basal, no boluses unless hyperglycemic until eating
- Blood Glucose Testing: minimum ever 4 to 6 hours, more for those on MDI or pumps (or IV insulin infusion)



Non-insulin Therapies

- The safety and efficacy of noninsulin glucose-lowering therapies in the hospital setting is an area of active research
- Some may be OK in hospital
- Remember drugs with renal contraindications or adjustments
- Saxagliptin and alogliptin should not be used in CHF
- Stable, non-critical patients may be on home therapies if appropriate



Insulin Pumps and CGM's

- Not a lot of data for CGM's in hospital
- If patient is stable and can manage devices with good result, can probably stay on
- Should still have fingersticks
- If not, IV or basal/bolus insulin



Discharge Planning

- Diabetes Education to include basic “survival skills” of diabetes at a minimum
- Meal plan- LRD consult
- SMBG training
- 1 week followup and beyond per ADA guidelines



Case Study #1

- 55 y/o male with known type 2 diabetes, hypertension, and dyslipidemia
- Quit smoking 5 years ago



Case #1

Current Medications

- Metformin 1000 mg BID
- Second Line agent
(per guidelines, could be SGLT-2, DPP-IV, GLP-1)
- Lisinopril 10 mg daily
- Atorvastatin 20 mg daily
- Aspirin 81 mg daily



Case #1

Admitted with Myocardial Infarction

Admission:

- A1C 8.1, blood glucose 260 random
- LDL 135
- Chemistries and CBC OK, Troponin elevated
- BP 165/100
- BMI 34
- Found to have multivessel disease on angiogram



Case #1

- CABG
- Cardiac Intensive Care
- So let's review what to do with his diabetes on this admit.....



Case #1

- Blood Glucose elevated on admit
- IV insulin infusion target blood glucose 140-180
- Likely hold other meds as NPO until eating
- If starts to eat before IV stopped, could give small boluses IV or SQ with food
- Elevated A1C on 2 agents, would at least consider basal insulin or a GLP-1 (preferred with CVD)
- LRD and CDE consult
- Needs high intensity statin and better BP control



Case #1

- What if serum creatinine 1.8 and GFR 36 on admit?
- What is lactic acid is elevated?
- What if infection present instead of coronary disease?



Case #2

- 22 year old female
- Type 1 on pump
- EOD mild DKA, blood glucose 565, obtunded
- No apparent illness

What next?

When to manage pump herself?



Case #2

- Blood alcohol 120
- How would this change your approach?



Type 1 on Pump in Hospital

- Ask them what they are doing, settings, etc
- If A1C in target (or close) without a lot of hypoglycemia outpatient, may be able to stay on
(they probably know what they are doing)
- If circumstances warrant, IV insulin infusion if best choice
- Even if on CGM, still need fingersticks for guidance



Case #3

- 62 year old female with type 1 diabetes on insulin pump and CGM
- Last A1C 6.8% 1 month ago
- HTN, dyslipidemia, retinopathy, neuropathy
- Meds:
 - Rapid acting insulin
 - Lisinopril
 - Atorvastatin
 - Metoprolol

Case #3

- Presents to Emergency room complaining of left arm weakness and lightheadedness
- Spouse thinks “she seems confused)
- Blood glucose on CGM is 332
- What now?

Case #3

- At this time, can't assume that patient can operate device
- Would switch to IV insulin in dose that might approximate pump dosing (units/hour, etc)
- Could leave on CGM, but would need frequent fingersticks at least short term until stable
- May be able to go back on device before discharge



Case #4

- 48 year old male with type 2 diabetes
- Last A1C 6 months ago 8.2%
- On “2 diabetes pills, statin, and blood pressure medicine”
- Presents to clinic with a cough, fever, and general malaise
- Blood Glucose is 165
- Diagnosed with bronchitis, patient insists something else is wrong (“Doesn't feel right”)
- Now what?



Case #4

- Medication list reveals metformin and SGLT-2 inhibitor
- What next?



Case #4

- Chemistries are normal except for blood glucose of 180
- CBC is normal other than mildly elevated WBC
- Urine reveals 2+ ketones
- Now what?



Case #4

- SGLT-2 can cause normoglycemic ketosis
- Would likely be off for awhile, may need something else, could try cautious reintroduction.



Reference

- **Diabetes Care in the Hospital: *Standards of Medical Care in Diabetes—2020***
- American Diabetes Association
- Diabetes Care 2020 Jan; 43(Supplement 1): S193-S202.
<https://doi.org/10.2337/dc20-S015>
https://care.diabetesjournals.org/content/43/Supplement_1/S193



Summary

Hospital

- Hospital guidelines are strongly evidence based
- Those who are good with diabetes as outpatients may be able to be active with inpatient management
- Transitions and education important

LTC

- Lots of diabetes in LTC
- Proper med choices are critical in older adults
- Factors such as life expectancy, CVD, CKD, mental status all important in making choices
- Balance medication burden, falls, hypoglycemia vs benefit
- Transitions important

