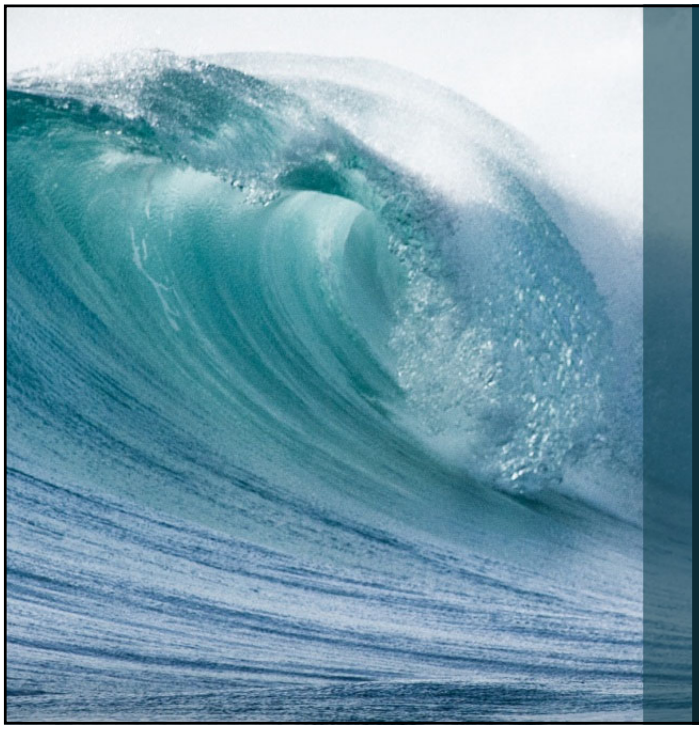

Inpatient Management of the Diabetic Patient

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Objectives

- Identify those patients in which screening of diabetes and intervention is necessary.
- Interpret blood glucose trends and perform effective glycemic management in hospitalized patients targeting blood glucose to published goals while preventing hypoglycemia.
- Provide higher quality of diabetes care in the inpatient population as a result of learned interventions.

Are Hospitals Doing Enough in Caring for Patients with Diabetes? Results of a Landmark Survey: Current State of Inpatient Diabetes Care and Glycemic Management (Rhinehart, et al, 2020)

- On average, 1/3 hospitalized patients requires insulin to control BG during their stay.
- Results of a nationwide survey indicate that prioritization of glycemic control is lacking, which increases risk of M&M.
- Online surgery of inpatient HCPs.
  - 70% HCPs felt glycemic control is "extremely" important.
  - Top 3 barriers to full adoption of Basal-Bolus insulin use: inadequate knowledge, belief that SSI is acceptable practice, and difficulty coordinating glucose monitoring, insulin administration, & meal times.
- *SURVERY SAYS*: Better glycemic control is necessary.
- A shift to quality care and safety is a must.

JES Journal of the Endocrine Society

General Knowledge of Your Patient

- Is your patient hyperglycemic?
- Distinguish if patient is Type 1 or Type 2
  - Need for basal at *all* times.
- Review home medications, most recent glycemic control, as well as reason for admission.
- Diet should be individualized
  - Body weight, appetite, and other comorbidities.
- FSBG should be monitored 4 times daily.
  - ACHS if eating, q6h if NPO.
  - Revise insulin dosing every 1-2 days based on previous day's BGs.

Acute or Chronic Hyperglycemia?

- Inpatient hyperglycemia is defined as BG >140 mg/dL.
- A1c can distinguish acute hyperglycemia that could be circumstantial vs undiagnosed diabetes.
  - On D5
  - Steroids
  - Stress hyperglycemia
  - Enteral and parenteral nutrition
  - Pharmacotherapy

- If patient is hyperglycemic and has a normal A1c, the same targets apply.

Glucose Targets

- BG >180: start insulin therapy
- Target BG 140-180 for non-critically ill patients
- Target BG 110-140 for select patients if hypoglycemia can be avoided.

ADA & AACE

For Patients on Oral Agents Prior to Admission

- If NPO and well controlled:
  - DC oral agents and use *temporary* SSI
- If NPO and poorly controlled:
  - Start on basal. SSI can be used 1-2 days to help approximate final doses.
- Eating and well controlled:
  - Continue oral agents, but DC metformin
- Eating and poorly controlled:
  - Consider adding additional agents.

NPO & Perioperative Management of Insulin-dependent Patients

Type 1 DM

- Consider IV insulin infusion
- Give ½ - ⅔ dose of intermediate or basal insulin with SSI…
- FSBG q6h, q1-2h if on insulin gtt
- Unless markedly hyperglycemic, provide D5
- *Cannot stop basal insulin in DM1!*

Type 2 DM

- May require SSI alone if NPO.
- Give ½ dose of intermediate or basal insulin with SSI…
- FSBG q6h
- Unless markedly hyperglycemic, provide D5
- Significantly insulin-dependent DM2 patients are more easily managed as if they are DM1
- Hold orals.

Hypoglycemia Management

- Alert & Cooperative Patient
  - Rule of 15: 15g CHO & check BG in 15 minutes, repeat til >70 mg/dl
    - 15g CHO: 4oz juice or milk or pack of graham crackers
- Non-Alert Patient
  - IV Access: 25g IV dextrose
  - No IV Access: 1mg glucagon IM +/- po glucose gel, if no risk of aspiration
- Persistent: consider continuous dextrose.
  - Identify cause and modify treatment as indicated: orals, insulin, AKI

Sliding Scales… or *Correction Factors?*

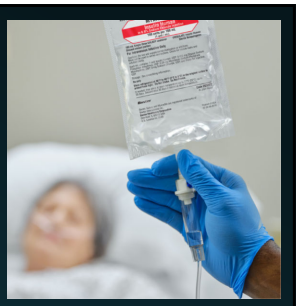
- First, choose aspart or lispro, as opposed to regular insulin.
- CFs should not be the sole treatment for hyperglycemia or diabetes in the hospitalized patient.
- Be proactive with the use of basal insulins in combination rapid acting insulins.
- Use CF to help determine prandial needs.

Different Scales

- Low SSI: Underweight, Insulin sensitive, AKI/CKD/ESRD.
- Moderate SSI: Most DM2
- High SSI: Insulin Resistant, Steroid therapy
- Individualized SSI: To avoid significant hyper- or hypoglycemia.

- Regular SSI should be given 30 minutes before meals.
- Aspart/Lispro should be given 5-15 minutes before meals.

Indications for IV Insulin Infusion



- Diabetic ketoacidosis
- Hyperosmolar hyperglycemic state
- Uncontrolled diabetes despite subcutaneous insulin
- Total parenteral nutrition
- Patients with DM1 who are NPO, perioperative, in L&D.
- Any patient post-MI with hyperglycemia
- Any ICU patient with hyperglycemia

Insulin Action Profiles

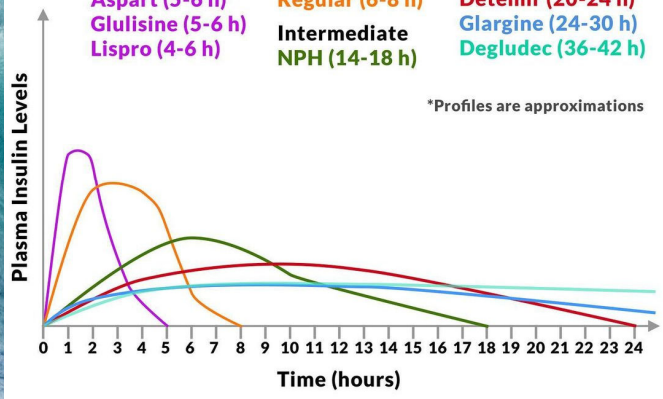
Rapid-Acting
Aspart (5-6 h)
Glulisine (5-6 h)
Lispro (4-6 h)

Short-Acting
Regular (6-8 h)

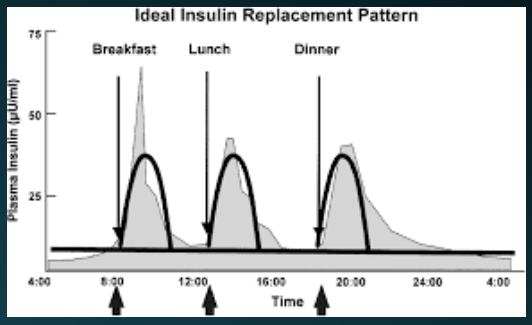
Intermediate
NPH (14-18 h)

Long-Acting
Detemir (20-24 h)
Glargine (24-30 h)
Degludec (36-42 h)

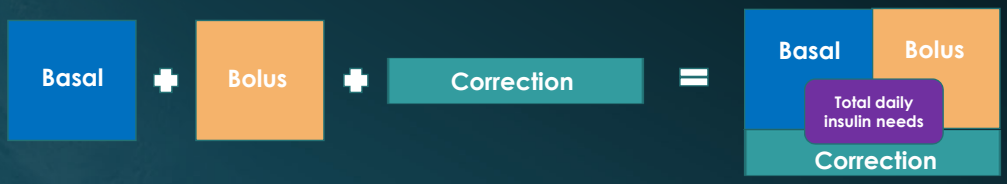
*Profiles are approximations



Adapted and referenced from: Hirsch IB. Insulin analogues. N Engl J Med. 2005 Jan 13;352(2):174-83. https://www.ncbi.nlm.nih.gov/pubmed/15647580 and individual product labels.



Basal-Bolus-Correctional Insulin Regimen



Scheduled

PRN

How to Start Insulin in a Newly Diagnosed Diabetic

- Calculate total daily dose (TDD)
  - By IV requirements
  - By weight:
    - Type 1, underweight, CKD: 0.3-0.4 units/kg/day
    - Type 2, obese, resistant: 0.4-0.6 units/kg/day
- Basal insulin requirement: 40-50% TDD
- Prandial insulin requirement: 50-60% TDD
- Correction dose: Based on insulin sensitivity & other factors.

TDD Transition from IV to SQ Insulin

- If IV insulin dose is 2u/h:
  - Basal requirement is 2u/h x 24h = 48 units
  - 48u x 80% = 38 units of basal SQ insulin
- Prandial requirements when on a diet:
  - 38u ÷ 3 meals = 13u with each meal.
- Correction Requirement:
  - *1700 Rule* estimates insulin sensitivity
  - 1700 ÷ TDD (48+38=86) = 20, approximately 25 = 1u lowers BG 25mg/dl

<u>Regimen</u>

- Basal 38u qd
- Prandial 13u ac tid
- CF: 1u per 25mg/dl above target

TDD SQ Insulin Based on Weight

- 80kg man x 0.6 u/kg = 48u TDD
- Basal insulin = 48 x 50% = 24u basal
- Prandial insulin = 24u ÷ 3 meals = 8u with each meal.
- Correction Requirement:
  - *1700 Rule* estimates insulin sensitivity
  - 1700 ÷ TDD (48) = 35 = 1u lowers BG 35mg/dl

<u>Regimen</u>

- Basal 24u qd
- Prandial 8u ac tid
- CF: 1u per 35mg/dl above target

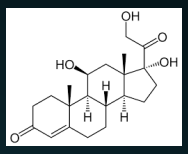
Non-Insulin Therapies

- Safety and efficacy of non-insulin agents in the inpatient setting is an area of active research.
- Several recent randomized trials have demonstrated potential effectiveness of GLP1a and DDP4i in specific patient groups.
- SGLT2i *not recommended*. Should be stopped 3-4 days prior to surgery.

Enteral & Parenteral Nutrition

- Continuous TFs or TPN
  - Basal: Some recommend NPH bid-tid, but this may lead to peaks/troughs and increase risk of hypoglycemia. Basal insulin is a reasonable alternative, BID dosing is more favorable.
  - Correctional: Regular insulin q6h or Rapid acting q4h.
  - If feeds are interrupted, D5 or D10 infusion must be started immediately to avoid hypoglycemia. Reevaluate insulin needs.
- Nocturnal/Cyclic TFs: NPH is useful for covering the nutritional load at initiation of cycle. This can be in addition to basal insulin.
- Bolus TFs: 1u:10-15g CHO SQ AC feeds, in addition to correctional. May be difficult if boluses are more than QID.
- TPN: Regular insulin usually incorporated into the bag, starting at 1u:10g dextrose. Dose increased depending on correctional insulin required in prior 24h.
- If DM1, patient will continue to require basal insulin.

Glucocorticoid Therapy



- Hyperglycemia may be induced with or without antecedent diabetes.
- GC type and duration of action should be considered to determine insulin regimen.
- Daily short-acting (prednisone) reach peal plasma levels in 4-6h but actions last all day. Overnight BGs may normalize.
- Twice daily GCs may respond well with concomitant NPH, on top of current regimen, with alternative of OAD.
- Long acting (dexamethasone) or very high dose steroids in general: Basal, Bolus, Correctional.
- Anticipate adjustment of doses when discontinuation or taper of steroids.

Perioperative Care Approach

- Target: 80-180 mg/dL; *tight control not advised*
- Perioperative risk assessment should be performed.
- Metformin should be withheld day of surgery.
- SGLT2i should be held 3-4 days before surgery.
- Withhold oral agents morning of surgery, and give
  - ½ dose NPH or 75-80% basal insulin or insulin pump basal
- While NPO monitor FSBG q2-4h and use SSI prn.
- No data on influence of GLP1a upon glycemia.

Transition to outpatient setting

- Should start on admission. Do not leave patients on Sliding Scale as the ONLY form of treatment.
- Not all patients that required insulin inpatient will require it outpatient.
- Improves patient satisfaction and reduces readmission.
- Identify early on if there is a provider to care for these issues outpatient.
- Involve nursing staff for education in finger sticks and insulin administration
- Consider Diabetes Education Consult.
- Sick day management.

Discharge Diabetic Algorithm

<7%	7-9%	>9%
Resume home treatment regimen	Resume home treatment, with addition of other agents or basal insulin	Discharge on basal bolus at same hospital dose. Or resume home regimen with addition of basal insulin.

Interactive Session!

Vignette A

- 68M with DM2 x8 years admitted for SOB and CHF.
- Treated with metformin and sitagliptin.
- Labs: BG 172 mg/dL, A1c 7.8%, Cr 1.3 mg/dL, eGFR 45 ml/min.
- WTD?

Vignette B

- 42M with DM2 x10 years and diabetic foot ulcer with osteomyelitis of left toe.
- Treated with metformin and glipizide.
- Labs: BG 294 mg/dL, A1c 9.2%, Cr 1.4 mg/dL, eGFR 60 ml/min.
- WTD?

Vignette C - 1

- 42M with DM2 for >15 years admitted for DFU x6w.
- Treated with metformin, pioglitazone, & glipizide.
- Labs: BG 323mg/dL, A1c 8.7%, Hg 8.7g/dL, Cr 3.4mg/dL, eGFR 19ml/min.
- On admission hospitalist started on glargine 25u qd & SSI.
- Podiatry consulted, and patient underwent I&D x3.
- WTD initially on admission?

Vignette C - 2

	5:51	11:08	16:07	20:29	6:30
BG	435	295	216	273	286
Glargine	25u				25u
Prandial	10u	--	10u		
Correction	12u	4u	4u	4u	

- On glargine 25u qd, aspart 10u ac tid, and CF 2:50>150.
- WTD?

Vignette C - 3

	6:14	11:00	16:17	20:29	6:49
BG	210	97	103	103	175
Glargine	26u				26u
Prandial	15u	15u	15u		
Correction	4u	--	--	4u	2u

- On glargine 26u qd, aspart 15u ac tid, and CF 2:50>150.
- WTD?

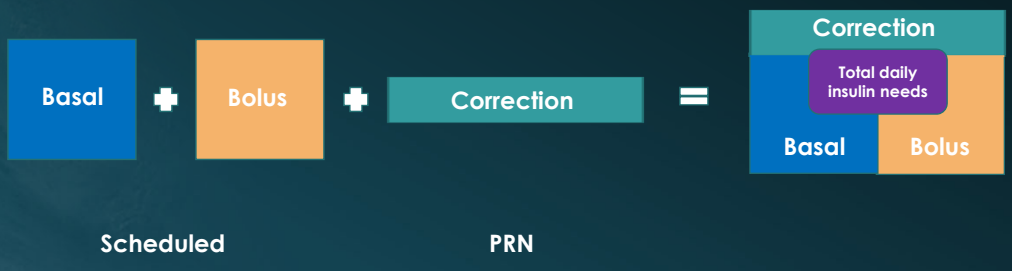
Vignette D

- 20F no PMH admitted for DKA, BMI 62.
- Labs on admission: BG 624mg/dL, A1c 16.2%, Cr 1.7mg/dL, eGFR 44ml/min.
- Over the last 6 hours required 12 units regular insulin.
- To bridge: assume that hourly requirement is 2u/h
  - Basal requirement is 2u/h x 24h = 48 units
  - 48u x 80% = 38 units of basal SQ insulin
- Prandial requirements if on a diet:
  - 38u ÷ 3 meals = 13u with each meal.
- Correction Requirement:
  - *1700 Rule* estimates insulin sensitivity
  - 1700 ÷ TDD (38+38=76) = 22, approximately 25 = 1u lowers BG 25mg/dl

Vignette E

- 59M admitted to BICU for extensive electrical burns.
- Labs on admission: BG 106mg/dl, A1c 6.1%, Cr 2.1mg/ml, eGFR 47 ml/min.
- Continuous HPHC tube feed is started for 24h/day.
- BG now in 200s.
- WTD?
- Patient has massive emesis of TFs, and they are held. WTD?
- Patient is started on HPHC oral diet in the day and put on nocturnal TFs to maximize caloric intake. WTD?

TAKE HOME MESSAGE



Inpatient Blood Glucose Goal: 140-180

Thank you!

Any questions?