Update on Inpatient Diabetes Management ICU Care

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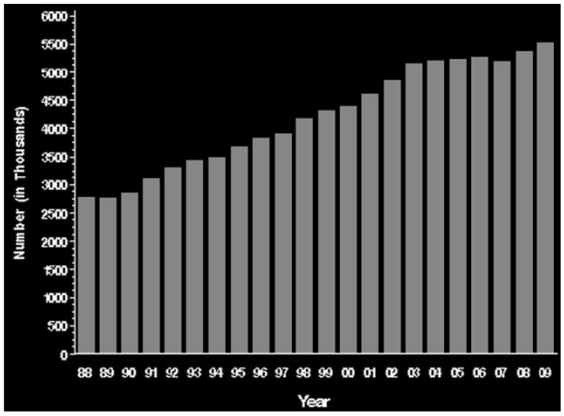
- Honoraria: UpToDate, Elsevier, CMHC, ACHL

Outline

- Background
- DKA
- IV Insulin
- Glucose Monitoring

Prevalence of Diabetes in the Hospital

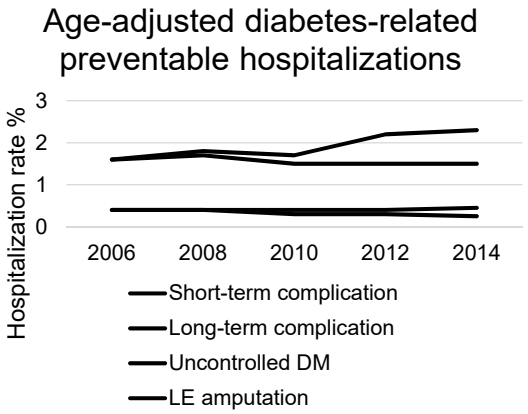
- 23% of all discharges
  - Higher LOS
  - Greater costs
  - More comorbidities
  - ~20% (1.7-1.9 million) are early readmissions with annual cost: $25 billion



CDC's Division of Diabetes Translation. Available at: www.cdc.gov/diabetes/statistics/dmany/fig1.htm.
https://www.cdc.gov/diabetes/home/index.html
Fraze et al. HCUP Statistical Brief #93, 2008, www.hcup-us.ahrq.gov
American Diabetes Association. *Diabetes Care*. Mar 6 2013.
Healthcare Cost and Utilization Project (HCUP). Agency for Healthcare Research and Quality (AHRQ). 2014. Available at: http://hcupnet.ahrq.gov/HCUPnet.jsp.

Diabetes Hospitalizations

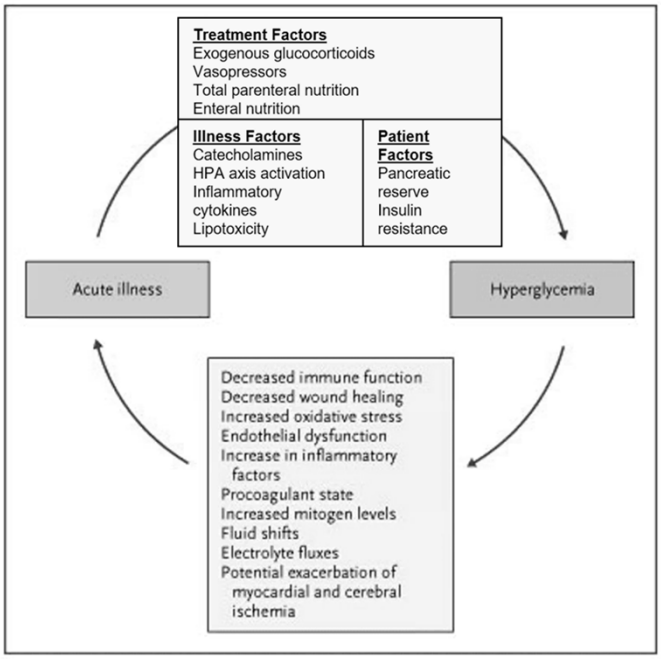
- In 2016, there were 7.8 million hospitalizations among patients with Dx code for DM[1]
- DM or hyperglycemia associated with greater[2]
  - Costs
  - LOS
  - Mortality
  - Complications
  - Readmissions



- Data extrapolated from National Inpatient Sample

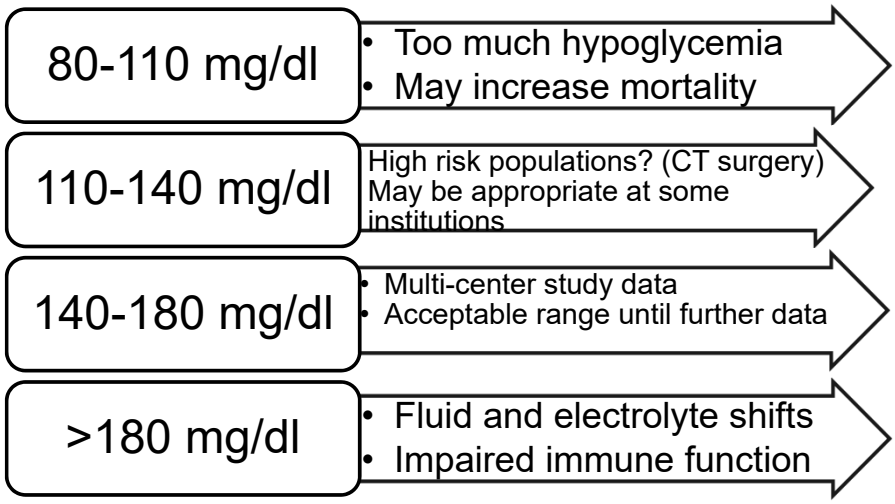
1. National diabetes statistics report 2020. https://www.cdc.gov/diabetes/pdfs/data/statistics/national-diabetes-statistics-report.pdf
2. Dhatariya et al. www.endotext.org
3. Rubens et al. Diabetes Care 2018;41:372-373

Isn't Hyperglycemia just an adaptive response to stress?



Inzucchi NEJM 2006;355 (18):1903

What should be the Target Glucose Range?



AACE/ADA CONSENSUS STATEMENT ON INPATIENT GLYCEMIC CONTROL; Endocr Pract 2009;15(4)
ADA Standards of Care;Diabetes Care 2021
Endocrine Society Guidelines 2013

Risk Factors for Hypoglycemia--ICU

	OR	95% CI
DM	2.6	1.5-4.7
Sepsis	2.2	1.2-4.1
CVVHD	3.7	1.6-8.6
↓CHO	6.6	1.9-23
Insulin prior to admit	17	2.3-127
Insulin use	5.4	2.8-10
Shock	1.8	1.1-2.9
Prior Hypoglycemia	2.3	1.1-4.7

Reduce insulin, increase monitoring if
- Any form of carbohydrate is interrupted
- Declining renal or hepatic function

Vriesendorp et al. Crit Care Med 2006;34:96

Consensus Definition of Ketoacidosis

- Consensus: ADA, AACE, AADE, Endocrine Society, JDRF, Pediatric Endocrine Society, T1D Exchange
  - Urine/serum ketones >ULN
  - Bicarb <15 mmol/l or pH <7.3
  - AG not included
  - Does not account for acidosis from other causes

Agiostratidou et al. Diab Care 2017;40(12):1622-1630

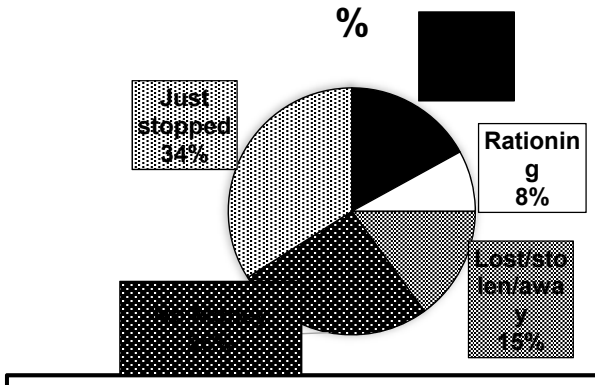
Risk Factors for DKA

- Retrospective cohort

	First DKA N=73	Recurrent DKA N=91	P-value
Age	41	41	0.71
BMI	29	26	0.05
DM duration	9.5	14.3	<0.0001
Homeless	6.9%	23%	0.005
Insured	26%	48%	0.01
Follows in DM clinic	27%	67%	<0.001
Prior DM Education	56%	84%	<0.0001
H/o depression	28%	42%	0.03
Alcohol	25%	40%	0.047
Illicit substance	23%	52%	<0.001
A1c	12.4%	12.1%	0.21

Randall et al. Dia Care 2011;34:1891-1896

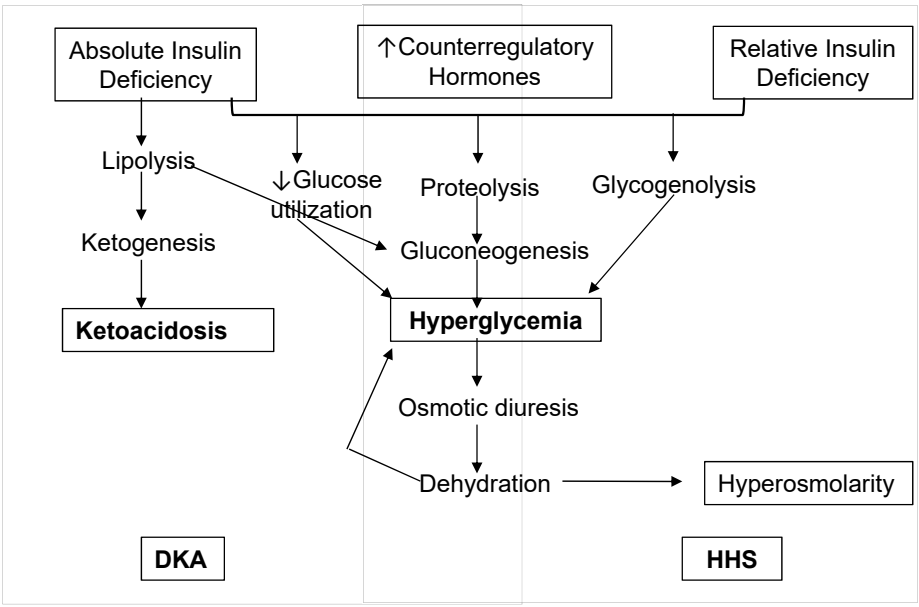
Reasons for stopping insulin



"Because most people learn best through repetition, diabetes education should be repeated at least yearly, with review of basic concepts and additional supplemental concepts as well as checks for understanding and modifications for patients with recurrent DKA."

Randall et al. Dia Care 2011;34:1891-1896

Pathogenesis of DKA



Diabetes Care 2009 Jul; 32(7): 1335-1343

DKA with SGLT2 inhibitors in patients with T2D

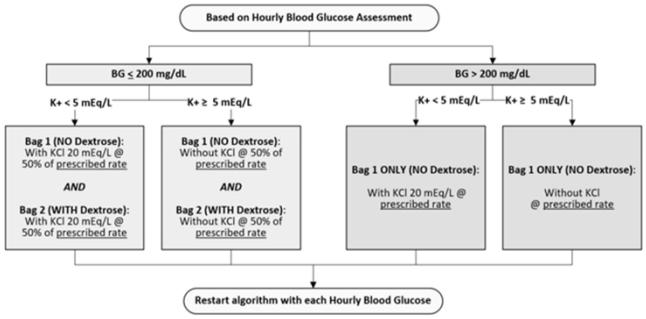
- Risk of DKA increased with SGLT2i ~2.2-2.5-fold[1]
- Mechanism:
  - Reduced ketone clearance
  - Glycosuria→*euglycemic* DKA
  - Natriuresis
  - ↑glucagon->lipolysis

Criteria for holding dose:[2]
- Symptoms consistent with DKA
- Fasting/inability to eat
- Dehydration
- Unusual physical activity
- Excess EtOH use
- Hospitalization/procedures (hold 3 days prior)

1. Fralick et al. N Engl J Med 2017;376(23):2300-02
2. Danne et al. Diabetes Care. 2019 Jun;42(6):1147-1154

DKA 2-bag Method

- Maintains constant fluid, electrolyte and insulin infusion while titrating 1 bag with dextrose and 1 without in response to changing BG
- Associated with
  - Earlier resolution of DKA[1,2]
  - Less waste of partially used fluids[1]
  - Possibly less hypoglycemia[2]



1. Haas et al. J Emerg Med. 2018;54(5):593-599
2. Munir et al. DI.BMJ Open Diabetes Res Care. 2017 Aug 11;5(1):e000395

Insulin Drip Protocol

When to initiate: 3 consecutive BG >200 mg/dL
Target: 120 -150 mg/dl

- Serum or capillary glucose q1hour.
- Dextrose at 10 ml/hour during infusion
- Initiate infusion at 2 units/hour.
- Rate of decline of glucose should be <100mg/dl/hour
- If patient is eating, administer SQ rapid acting insulin.
- Hypoglycemia alone does not justify prolonged cessation

5 columns= greater precision

Discrete increments

Higher target= larger cushion

Greater dose reductions

Higher stopping threshold= larger cushion

Table 1. IV Insulin Infusion

Current Glucose	Change in Glucose from Prior Measure					
	Decreased > 100 mg/dL[1]	Decreased 50-100 mg/dL	Decreased 25-50 mg/dL	Increased or decreased < 25 mg/dL	Increased 25-50 mg/dL	Increased > 50 mg/dL
> 400 mg/dL	• Contact the prescriber. • Increase infusion rate according to the row for 301-400 mg/dL. • If glucose is > 400 mg/dL and the decline in glucose is < 25 mg/dL per hour for two consecutive glucose checks, consider doubling the rate of infusion.					
301-400 mg/dL	No Change	**Increase** infusion rate by 1 unit/hr	**Increase** infusion rate by 2 units/hr	**Increase** infusion rate by 2.5 units/hr	**Increase** infusion rate by 3 units/hr	**Increase** infusion by 4 units/hr
201-300 mg/dL	Run infusion at **75%** of current rate[3]	No Change	**Increase** infusion by 1 unit/hr	**Increase** infusion rate by 1 unit/hr	**Increase** infusion by 2 units/hr	**Increase** infusion by 3 units/hr
151-200 mg/dL	R… 50… ra…					…crease …usion …2 unit/hr
120-150 mg/dL **OPTIMAL**	R… 25… ra…					…crease …usion by 1 …t/hr
80-120 mg/dL	**S…** in… co… pr… re… in 15 minutes					…Change
< 80 mg/dL	• Stop infusion of insulin and contact the prescriber. • Double current infusion rate of dextrose solution. • If not receiving dextrose IV infusion, start D5W at 50 ml/hr. • **Consider** giving D50% according to the **Hypoglycemia Treatment in Non-Pregnant Adults** guideline. o Recheck glucose and treat according to the Hypoglycemia Treatment in Non-Pregnant Adults guideline every 15 minutes until glucose > 80 mg/dL. • **Resume insulin at 25% of previous dose and reduce dextrose back to previous rate** when glucose > 150 mg/dL in the absence of subcutaneous basal insulin (detemir, glargine, NPH). • This applies to patients with type 2 diabetes or other causes of hyperglycemia. Click here to access the OSUWMC **Type 1 Diabetes Mellitus (T1DM) and Diabetic Ketoacidosis (DKA)** guideline.					

[1] Contact prescriber if rate of decline in glucose **>100 mg/dL/hr**. Patient may need a more rapid taper of the drip than indicated in the table above.

Determinants of insulin adjustment
- Change in BG
- Direction of change in BG
- Current BG
- Current infusion rate

Separate Guidelines: Differ in aggressiveness
Type 1 Diabetes/DKA
Type 2 Diabetes/Other Hyperglycemia

Computerized algorithms

- May be integrated within EMR
- Learns patient insulin sensitivity
- Built-in meal boluses
- Fewer fingerstick BG, more timely
- Less nursing judgement, time, more satisfaction
- Meta-analysis (13 studies) vs. paper algorithm
  - ↓mean glucose -23.74, (95% CI: -24.45 - -23.02), p <0.00001
  - ↑ % of time in target.
  - ↓ hyperglycemia (1.3 ± 1.2% vs 6.5 ± 2%, p<0.05).

Higgs M, Fernandez R. JBI Database System Rev Implement Rep. 2015;13(5):205-43.

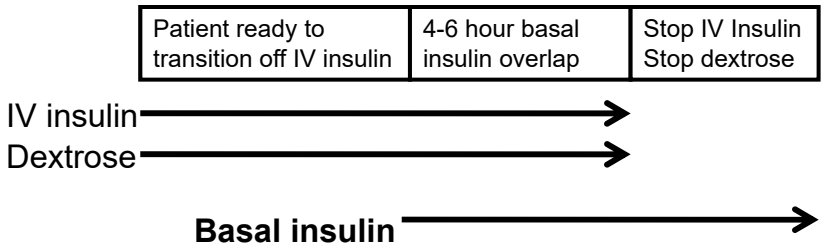
Physiologic Insulin Regimen

3 Components

		Examples
	Basal	Long-acting insulin analogue NPH Continuous SQ rapid acting insulin analogue (pump) IV insulin drip
BOLUS	**Prandial**	Rapid-acting insulin analogue Regular insulin (tube feeds)
BOLUS	**Correction (supplemental)**	See prandial insulin IV insulin drip

Rapid acting insulin analogues: Aspart (Novolog), Lispro (Humalog), Glulisine (Apidra); Long acting insulin analogues: glargine (Lantus), detemir (levemir)

Conversion to SQ Insulin



Basal insulin dose = Average infusion rate X 15

2 unit/hr x 15 = 30 units

- Assumes that the drip is not being used for meal coverage
- Compare to home dose of insulin and weight-based needs

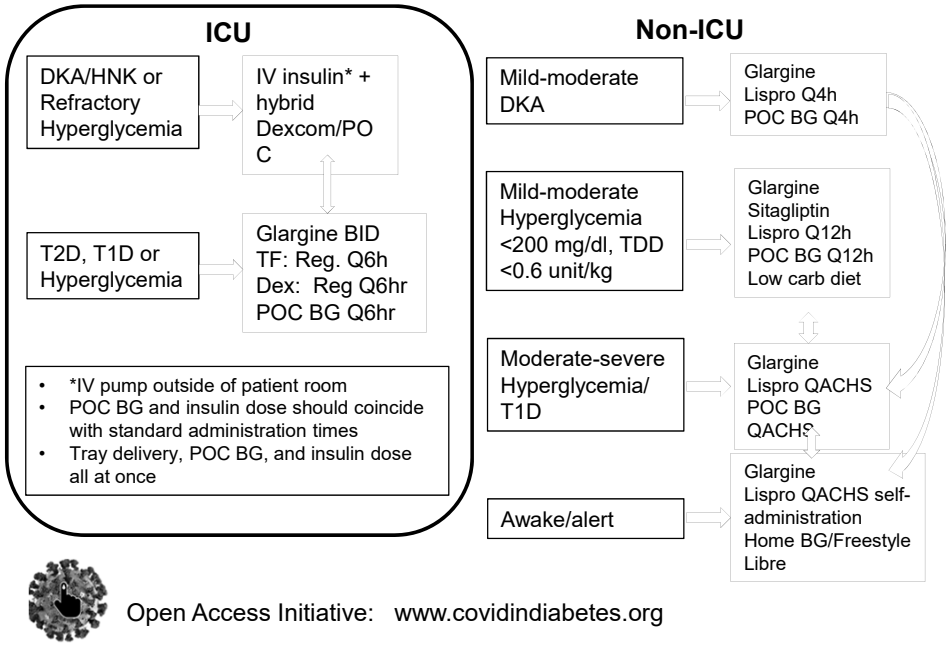
Tube Feeds Possible Approaches:

	Continuous TF	Overnight TF
Basal Insulin	<50% of TDD (basal insulin not always necessary)	
Regular	50-100% of TDD divided evenly Q6hr	30 min. prior to start of TF and midway
NPH (optional)		30 min prior to start of TF
Correction dose regular insulin	prn Q6hr	prn Q6hr

Anticipatory orders are crucial:

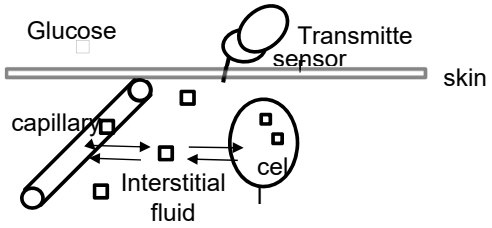
- Hold if TF stop or anticipated to stop within 6 hours of dose
- Hold if BG <100
- If unanticipated TF cessation: check BG Q1hr x 6hr and start D5 at same rate TF were running until TF restart or 6 hours after last dose of regular insulin

COVID-19 Inpatient DM Algorithms



Open Access Initiative: www.covidindiabetes.org

Continuous Glucose Monitoring



- Physiologic Lag 10-15 min between blood and interstitial fluid
- Inaccuracy at low BG, rapid glucose swings
- Home BG devices not approved in hospital—*exceptions for COVID*[1]
- ICU data[2]:
  - Small studies
  - Variable accuracy, not tested over robust glucose ranges
  - Acceptable safety, modest effect on glucose control
  - Reduce nursing workload

What about a hybrid strategy using POC BG and CGM?

1. https://www.fda.gov/regulatory-information/search-fda-guidance-documents/enforcement-policy-non-invasive-remote-monitoring-devices-used-support-patient-monitoring-during
2. Umpierrez and Klonoff. Diabetes Care. 2018 Aug;41(8):1579-1589.

Can a Hybrid BG and CGM Model be used safely in the ICU?

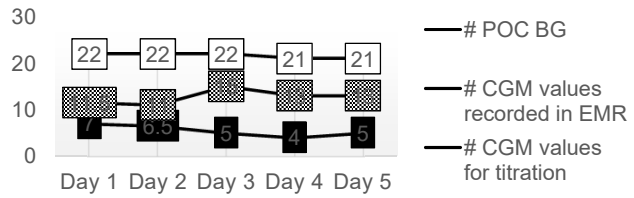
Stage	POC Glucose Testing Procedures
Initial CGM Validation	Proceed to Q6 hour POC testing when 2 consecutive hourly POC readings meet criteria: 1. CGM within 20% of POC (POC > 100 mg/dl) 2. CGM within 20 mg/dl of POC (POC < 100 mg/dl)
Ongoing Validation	• Revert from Q6 hour to Q1 hour POC if any CGM value does not meet the validation criteria
	• Obtain 1 time POC glucose if: 1) No CGM value 2) No trend arrow 3) Urgent low soon or low threshold alert 4) Signs and symptoms do not match glucose readings 5) Change in clinical status, such as intubation, hemodynamic compromise, or change in nutrition 6) New sensor

Not FDA approved

Mitigation of Risk:
Sensor validation
Alert threshold 100 mg/dl
Predictive alert
Continuous data
Clinical context
Diabetes consult

High level results

- 19 patients, Vent: 89%, Vasopressor: 37%, Dialysis: 42%
- Median time to validation: 137 min (IQR 114, 206)
- MARD: 13.9—no apparent effect of O2 sat, MAP, vasopressor, renal replacement, anticoagulation, vent support
- TIR (70-180 mg/dl)
  - Day 1: 64±23%
  - Day 2-7: 72±16%
- TBR (70 mg/dl)
  - Day 1: 1.5 +/-4.1%
  - Day 2-7: 0.16 +/- 0.35%



Initial treatment of diabetic ketoacidosis in the emergency department

Minimizing blood loss in patients getting hourly blood glucose tests

Inpatient Diabetes Management in the Non-ICU Setting

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Outline

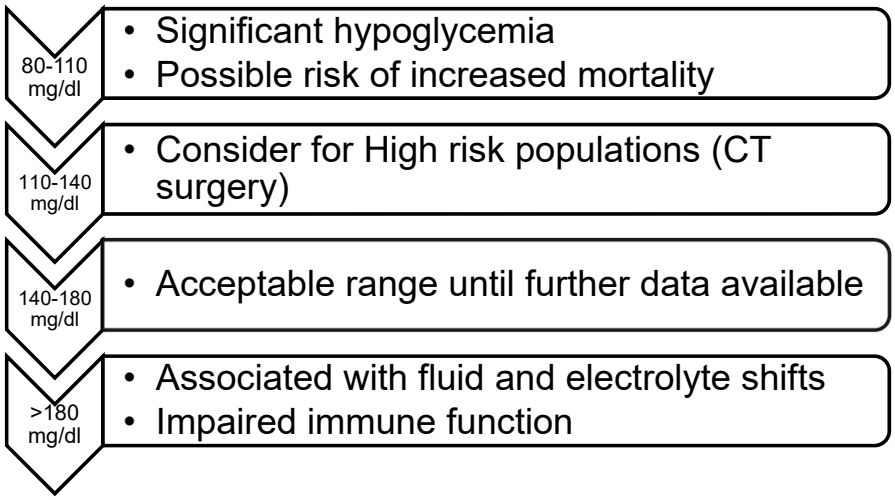
- Background
- Target Glucoses
- Inpatient Therapy
- Hospital Discharge Planning

Prevalence of Diabetes in the Hospital

- Diabetes
  -34.2 million people have diabetes (10.5% of the US population)
- Prediabetes
  -88 million people aged 18 years or older have prediabetes (34.5% of the adult US population)
- 23% of all hospital discharges
  - Higher length of stay
  - ~20% (1.7-1.9 million) are early readmissions with annual cost: $25 billion

CDC's Division of Diabetes Translation. Available at: www.cdc.gov/diabetes/statistics/dmany/fig1.htm.
https://www.cdc.gov/diabetes/home/index.html
Fraze et al. HCUP Statistical Brief #93, 2008, www.hcup-us.ahrq.gov
American Diabetes Association. *Diabetes Care.* Mar 6 2013.
Healthcare Cost and Utilization Project (HCUP). Agency for Healthcare Research and Quality (AHRQ). 2014. Available at: http://hcupnet.ahrq.gov/HCUPnet.jsp.

What should be the Target Glucose Range?



AACE/ADA CONSENSUS STATEMENT ON INPATIENT GLYCEMIC CONTROL; Endocr Pract 2009;15(4)
ADA Standards of Care;Diabetes Care 2019
Endocrine Society Guidelines 2013

14. Diabetes Care in the Hospital: *Standards of Medical Care in Diabetes—2018*

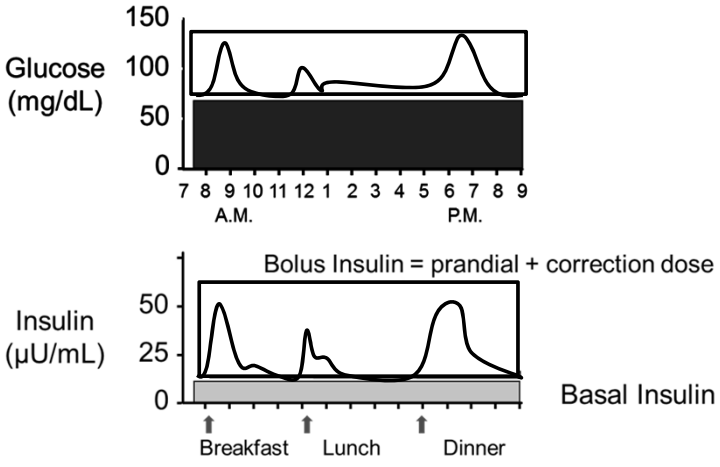
American Diabetes Association

Diabetes Care 2018;41(Suppl. 1):S144–S151 | https://doi.org/10.2337/dc18-S014

- The preferred treatment for non-critically ill patients is a basal plus bolus correction regimen.
- For those with good nutritional intake carbohydrate coverage should be added as well

Physiologic Insulin Regimen

Pancreatic Insulin Production



Determining Insulin Dosing

Total Daily Insulin Dose = (0.3-0.5 units/kg)(Total body weight in kg)

Typically half of the total daily dose is given as a basal insulin (0.15-0.25 units/kg)

Typically the remaining half is given as mealtime/bolus coverage if the patient is felt to be a candidate for bolus coverage

Basal Insulin Initiation in Patients not Receiving IV Insulin Therapy

	Insulin naïve	Not insulin naïve
Age >70 years +/- GFR < 60 ml/min	0.1-0.15 unit/kg	Evaluate based upon home medication adherence, home BG trends, A1c on admission, current oral intake, additional factors (such as renal function)
BG between 140-200 mg/dL	0.20 units/kg	
BG > 200 mg/dL	0.25 units/kg	

Endocrine Society Guidelines 2012

Basal insulins

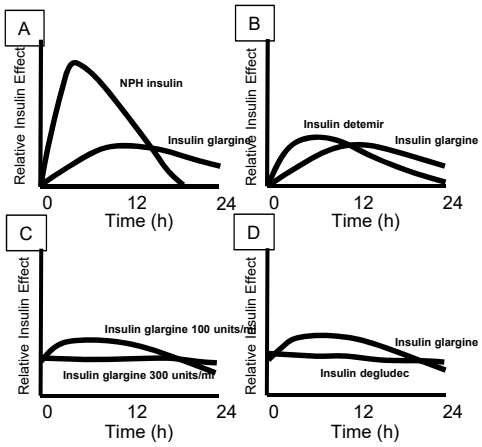
The Ohio State University Wexner Medical Center
and The James Comprehensive Cancer Center

INSULIN INTERCHANGE GUIDELINES

- **Therapeutic interchange**:
  - Glargine U100→U300: 1:1
  - Glargine U300→U100: decrease dose 20%
  - Degludec → other: 1:1, consider dose reduction

Preparation	Onset	Peak	Duration	Vial	Disposable Pens and Pen with Cartridges		
					Dosing Range per injection (Unit)	Dosing Increment per Injection (Unit)	Dispensing Amount
Basal Insulin							
NPH Daily or BID	1-2 hr	4-8 hr	10-20 hr	10 mL, 1000 unit	Kwikpen: 1-60	1	Pen: 3 ml, 300 unit
Detemir *Levemir*	3-4 hr	Nearly flat	Up to 24 hr	10 mL, 1000 unit	Flextouch: 1-80	1	Pen: 3 ml, 300 unit
Glargine (U100) *Lantus/Basaglar*	3-4 hr	Nearly flat	Approx 24 hr	10 mL, 1000 unit	Solostar: 1-80	1	Pen: 3 ml, 300 unit
Glargine (U300) *Toujeo*	6 hr	Flat	24-30 hr	N/A	Solostar: 1-80	1	Pen: 1.5 ml, 450 unit
Degludec (U100) *Tresiba*	1 hr	Flat	24-30 hr	N/A	Flextouch: 1-80	1	Pen: 3 ml, 300 unit
Degludec (U200) *Tresiba*	1 hr	Flat	24-30 hr	N/A	Flextouch: 2-160	2	Pen: 3 ml, 600 unit

Ultra-Long-Acting Insulins



Key Features:

- Flatter profile
- Longer duration
- Less hypoglycemia
- Once daily dosing

Pettus et al. Diabetes Metab Res Rev 2015;

Bolus Insulins

Preparation	Action Onset	Peak	Action Duration	Vial	Disposable Pens and Pen with Cartridges		
					Dosing Range per injection (Unit)	Dosing Increment per Injection (Unit)	Dispensing Amount
Bolus Insulin							
Regular	30 min	2-4 hr	6 hr	10 mL, 1000 unit	Kwikpen: 1-60 NovoPen3 PenMate: 1-60	1	Pen: 3 ml, 300 unit Cartridge: 3 ml, 300 unit
Aspart *Novolog*	15 min	1-2 hr	4 hr	10 mL, 1000 unit	Echo: 0.5-30	0.5	Cartridge: 3 ml, 300 unit
				N/A	Flextouch: 1-60	1	Pen: 3 ml, 300 unit
Glulisine *Admelog*	15 min	1-2 hr	4 hr	10 mL, 1000 unit	Solostar pen: 1-80	1	Pen: 3 ml, 300 unit
Lispro (U100) *Humalog* *Admelog*	15 min	1-2 hr	4 hr	10 mL, 1000 unit N/A	Luxura: 0.5-30	0.5	Cartridge: 3 ml, 300 unit
					Kwikpen/Solostar: 1-60	1	Pen: 3 ml, 300 unit
					Kwikpen: 0.5-30	0.5	Pen 3 ml, 300 unit
Lispro (U200) *Humalog*	15 min	1-2 hr	4 hr	N/A	Kwikpen: 1-60	1	Pen: 3 ml, 300 unit
Fiasp.	10 min	1 hr	3.5 hr	10 mL, 1000 unit	Flextouch: 1-60		
					Cartridge: 0.5-30		

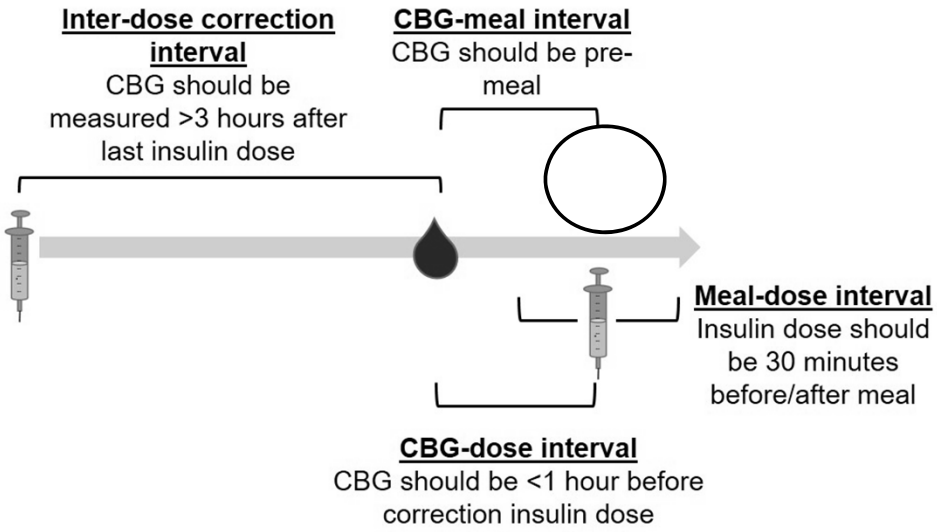
-Less hypoglycemia with insulin analogs compared to regular human insulin

OSU Rapid Acting Insulin Order Panels

	Approximate total daily dose	I:CHO	Supplemental
Low	<20 unit	1 unit/20 gm	1 unit/100 mg/dl
Standard	**20-60**	**1 unit/10 gm**	1 unit/50 mg/dl
High	60-100	1 unit/5 gm	**1 unit/25 mg/dl**

Insulin:Carb ratio = 500/total daily dose of insulin
Supplemental (correction) factor: 1 unit per (1500/total daily dose) mg/dl

Timing of Insulin Doses in the Hospital



CBG=capillary blood glucose

Dungan KM. Curr Diab Report 2019

Should Non-Insulin Agents be Discontinued Inpatient?

Factors to influence decision: short hospital stays, previous good control, no contra-indications

- DPP-IV inhibitors well tolerated but have limited efficacy.
- Continue home weekly GLP-1`

Caution	MTF	SFU	TZD	DPP-4i	SGLT2i	GLP-1 RA	Insulin
Kidney disease	Risk of lactic acidosis	Prolonged hypoglycemia	Fluid overload	Adjust dose	Fluid shift	GI side effects→ fluid status	Reduced clearance
Hypoglycemia	N	Y	N	N	N	N	Y
Other	GI side effects Lactic acidosis (IV contrast)		Heart failure	?Pancreatitis	GU infection DKA	GI side effects ?Pancreatitis	
Examples	Metformin	Glimepiride Glipizide Glyburide	Pioglitazone	Sitagliptin Linagliptin Saxagliptin Alogliptin	Empagliflozin Canagliflozin Dapagliflozin Ertugliflozin	Exenatide Exenatide QW Liraglutide Dulaglutide Semaglutide	See other

MTF=metformin, SFU=Sulfonylureas, TZD=thiazolidinediones, GLP-1RA= Glucagon-like Peptide-1 Receptor agonist, SGLT2i=Sodium-Glucose Cotransporter-2 inhibitor.

What to do for a Procedure

- As a general rule DO NOT HOLD basal insulin
  - Consider reducing by 20-50%, especially if there is suspicion that it is being used for prandial coverage (basal insulin >50% of total daily insulin dose)
- Do hold meal time insulin

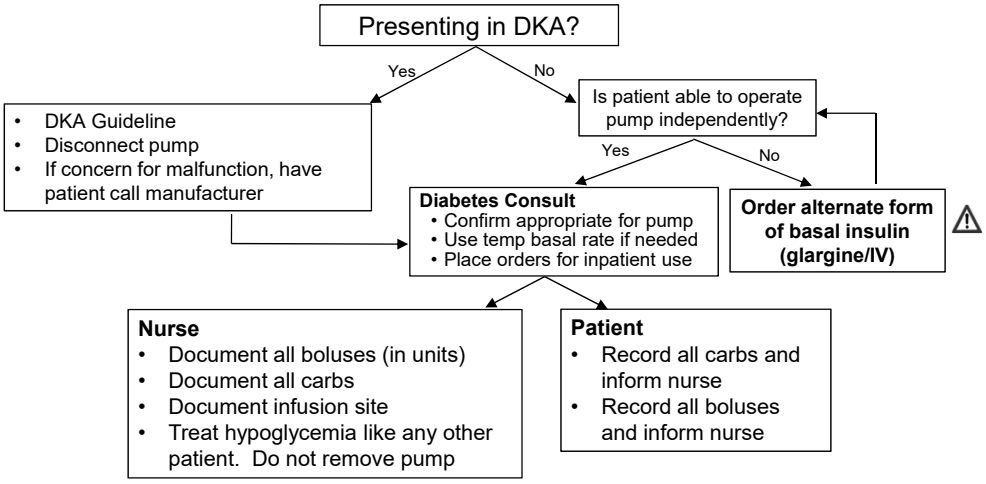
*Under no circumstances should you withhold basal insulin from a patient with Type 1 Diabetes!

Pulsed Steroid Dosing

- Difficult to control
- Treatment
  - Insulin drip
  - NPH 0.5 units per 1 mg of prednisone is an option
  - Increase prandial insulin (e.g. 1:10 → 1:5)
  - If NPO use regular insulin for correction every 6 hours
- Preemptively reduce insulin in anticipation of reduction in steroid dosing

Clore et al. Endocr Pract. 2009;15:469-474

What to do if a patient is admitted with on an insulin pump?



Glucose Testing

- Glucometers typically have approval for hospital use for venous and arterial specimens
- Capillary use MAY not be intended for those that are critically ill
  - Capillary whole blood specimens (e.g. obtained by finger stick) should not be used in patients receiving *intensive medical intervention/therapy* ...
    - Examples include…*severe hypotension, shock, hyper-osmolar-hyperglycemia (with or without ketosis), and severe dehydration*.

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Hypoglycemia

THE OHIO STATE UNIVERSITY WEXNER MEDICAL CENTER

Hypoglycemia Treatment in Non-Pregnant Adults

Goal

This guideline is designed to treat events of hypoglycemia, either spontaneous or insulin-induced, and to decrease glycemic variability associated with treatment of hypoglycemia.

- A hypoglycemia management protocol should be adopted and implemented by each hospital
- Each patient should have an established plan for treating hypoglycemia
- Hypoglycemia should be tracked and documented in the medical record

Diabetes Care 2018;41(Suppl. 1):S144–S151 | https://doi.org/10.2337/dc18-S014

OSU Hypoglycemia Treatment Guideline

Treat based upon BG level
Recheck Q15 min until BG >80 mg/dl

Table 1. Patients Who Are Alert with Available Enteral Access and Intact Cognitive Status

Blood Glucose (BG) Level	Action*			Follow Up
60-69 mg/dl or 70-79 with symptoms	**Next meal less than 1 hr** (15 g oral carbohydrate, choose one) • 4 oz juice or regular soda • 1 tbsp jelly or sugar • 3 glucose tablets • 1 tube dextrose gel	**Next meal 1-2 hrs** (choose one) • 3 graham crackers • 6 saltine crackers • 8 oz skim milk	**Next meal more than 2 hrs** (choose one) • ½ sandwich • 3 graham crackers with one tbsp peanut butter	• Recheck BG **q15 min** and treat accordingly until ≥ 80 mg/dl • Once BG ≥80 mg/dl, recheck BG **q1h x 2**, then resume point-of-care glucose as previously ordered
45-59 mg/dl	**Next meal less than 1 hr** (20 g oral carbohydrate, choose one) • 6 oz juice or regular pop • 1 ½ tbsp of jelly or sugar • 4 glucose tablets • 1 ½ tubes dextrose gel	**Next meal 1-2 hrs** (choose one) • 3 graham crackers • 6 saltine crackers • 8 oz skim milk	**Next meal more than 2 hrs** (choose one) • ½ sandwich (15 g) • 3 graham crackers with one tbsp peanut butter	
	Call House Officer to report BG and action taken			
<45 mg/dl	**Next meal less than 1 hour** (30 g oral carbohydrate, choose one) • 8 oz juice or regular soda • 2 tbsp jelly or sugar • 6 glucose tablets • 2 tubes dextrose gel	**Next meal 1-2 hours** (choose one) • 3 graham crackers • 6 saltine crackers • 8 oz skim milk	**Next meal more than 2 hours** (choose one) • 1 sandwich (30 g) • 3 graham crackers with one tbsp peanut butter	• Recheck BG **q15 min** and treat accordingly until ≥80 mg/dl. • Once BG >80 mg/dl, recheck BG **q1h x 4**, then resume point-of-care glucose as previously ordered
	Call House Officer to report BG and action ten			

*Choose one item from one column based on next meal time. If the next meal is 1-2 hours away, include complex carbohydrate as suggested by the examples. If the next meal is >2 hours away include protein as suggested by the examples.

If patient is uncooperative or does not have available enteral access, see Table 2, next page.

Van Berkel et al. Intensive Crit Care Nurs. 2017 Aug 4. pii: S0964-3397(17)30063-0.

Risk Factors for Inpatient Hypoglycemia

	OR	95% CI
DM	2.6	1.5-4.7
Sepsis	2.2	1.2-4.1
↓CHO Intake	6.6	1.9-23
Inpatient Insulin use	5.4	2.8-10
Shock	1.8	1.1-2.9
Prior History of Hypoglycemia	2.3	1.1-4.7

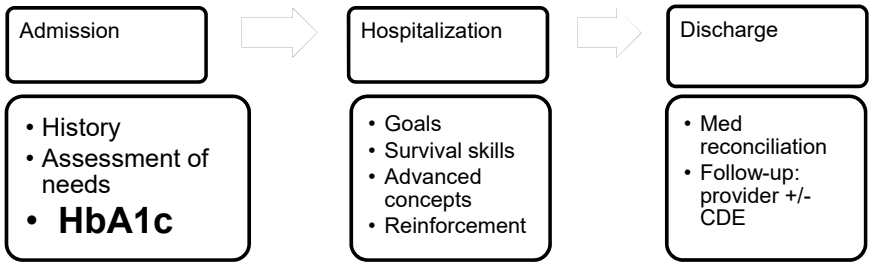
Reduce insulin, increase monitoring if
- Any form of carbohydrate is interrupted
- In setting of declining renal or hepatic function

Vriesendorp et al. Crit Care Med 2006;34:96

Discharge Planning

Discharge Planning

- There should be a structured discharge plan tailored to the individual patient with diabetes
- Perform an A1c on all patients with diabetes or hyperglycemia admitted to the hospital (if not done in the prior 3 months)



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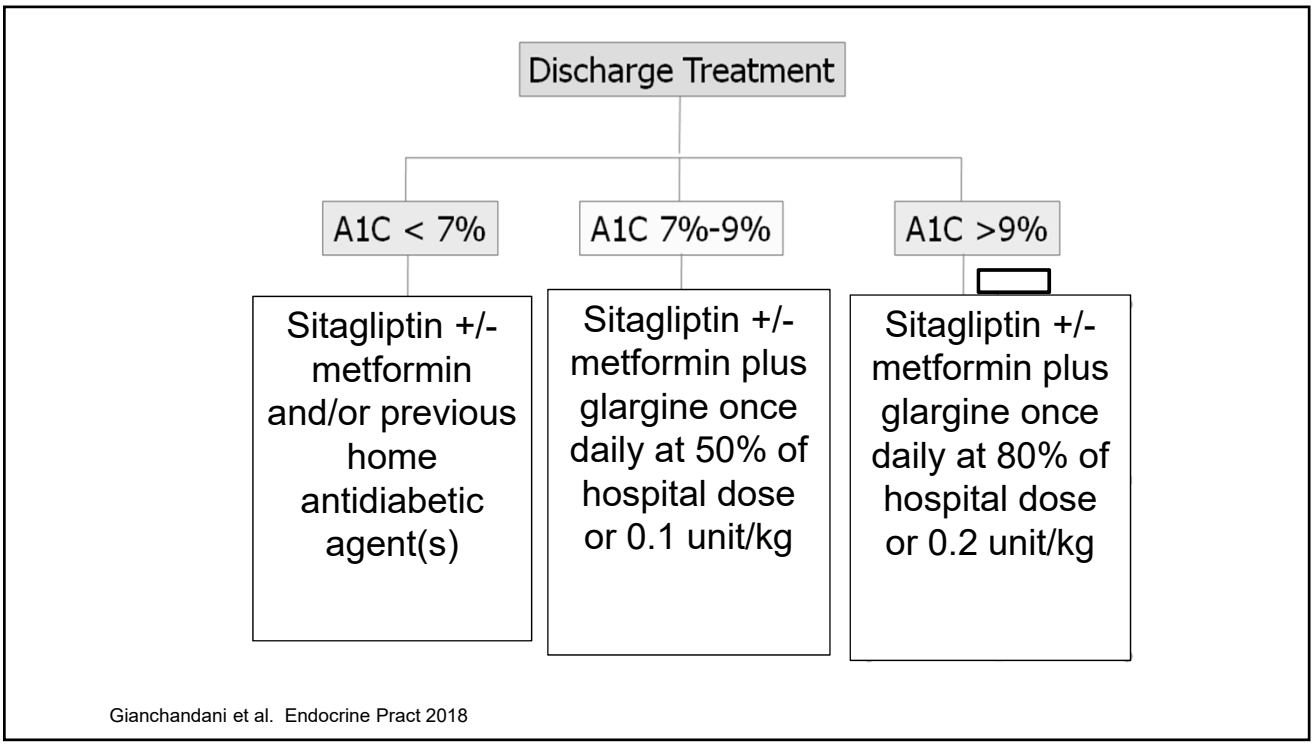
ADA/AACE Recommendations

The mean hospital LOS is usually <5 days and the capacity to learn new material may be limited during acute illness. Diabetes-related education is frequently limited to an inventory of basic "survival skills."

- Level of understanding pertaining to diabetes
- Self-monitoring of BG and home BG goals
- Definition, recognition, treatment, and prevention of hyperglycemia and hypoglycemia
- Consistent eating patterns
- When and how to properly take BG-lowering medications, including insulin
- Sick day management
- Proper use and disposal of needles and syringes
- Hospital follow-up plans

Moghissi et al. Diabetes Care. 2009 Jun;32(6):1119-31



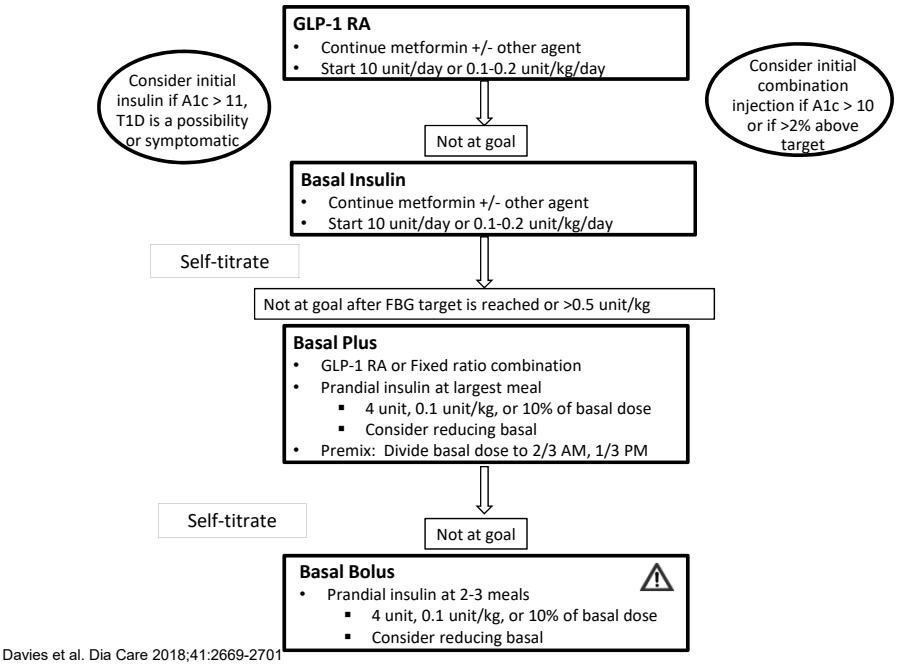
Gianchandani et al. Endocrine Pract 2018

ADA Guidelines for Non-Insulin Therapies

ASCVD	HF or CKD	Hypoglycemia	Weight Gain	Cost
GLP-1RA or SGLT2i*	SGLT2i* or GLP-1RA	SGLT2i* GLP-1RA DPP-4i TZD	GLP-1RA SGLT2i*	SFU TZD
Other agent demonstrating CV safety: • DPP4i (Sitagliptin, Linagliptin)		Other agent • Colesevalem • Bromocriptine QR • AGI • *later generation SFU, Ultra-long acting basal insulin*	Other agent • Colesevalem • Bromocriptine QR • AGI • *Minimize SFU, insulin, TZD*	Other agent • AGI • insulin

*if eGFR is adequate

Davies et al. Dia Care 2018;41:2669-2701



Oral therapy in combination with injectable therapies

- Metformin: continue
- DPP4i: stop if using GLP-1RA
- SFU: stop or reduce dose with insulin
- TZD: stop or reduce dose with insulin
- SGLT2i: continue but beware of DKA in insulin requiring patients (provide sick day rules)

Davies et al. Dia Care 2018;41:2669-2701

Conclusions

1. Diabetes is a very common diagnosis in the inpatient setting
2. Hospitalization provides an opportunity to identify and help improve glycemic control
3. Standard protocols help promote consistency and facilitate education
4. Transitions of care back to the outpatient setting can create challenges to glycemic control