OAAPN - Inpatient Diabetes Care: The Landscape for Management and Technologies in 2023

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Objectives

1. Discuss inpatient diabetes standards of care and best practices for glucose management
2. Describe recommended pharmacological therapies to treat hyperglycemia in the acute care setting
3. Review common challenges of Diabetes Care in the hospital
4. Compare and contrast between the types of diabetes technology

Slides : many are transition and resource slides for reference

2

Acknowledge OSUWMC
DM Team inpt and outpt

Some slides courtesy of team !!

QA join in and after…

Collaborative, resources included in this presentation:

CARDI·OH

Ohio Cardiovascular and Diabetes Health Collaborative

About Cardi-OH

Founded in 2017, the mission of Cardi-OH is to improve cardiovascular and diabetes health outcomes and eliminate disparities in Ohio's Medicaid population.

WHO WE ARE: An initiative of health care professionals across Ohio's seven medical schools.

WHAT WE DO: Identify, produce and disseminate evidence-based cardiovascular and diabetes best practices to primary care teams.

HOW WE DO IT: Utilize monthly newsletters and an online repository of resources at Cardi-OH.org, podcasts available on Cardi-OH Radio, and the Project ECHO® virtual training model.

Learn more at cardi-oh.org

School of Medicine Case Western Reserve University

In partnership with:

The Ohio State University Wexner Medical Center

Northeast Ohio Medical University

University of Cincinnati

Wright State University Boonshoft School of Medicine

Ohio Department of Medicaid

CARDI·OH

Ohio Cardiovascular and Diabetes Health Collaborative

Interpretation of Continuous Glucose Monitoring in Primary Care: A Case-Based Approach

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Acknowledgement

Director, Division of Endocrinology, Diabetes & Metabolism

Cardi-OH ECHO

What's New in Cardiovascular Prevention? A Series of Case-Based Discussions

September 29, 2022

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For more information, head to Cardi-OH.org.

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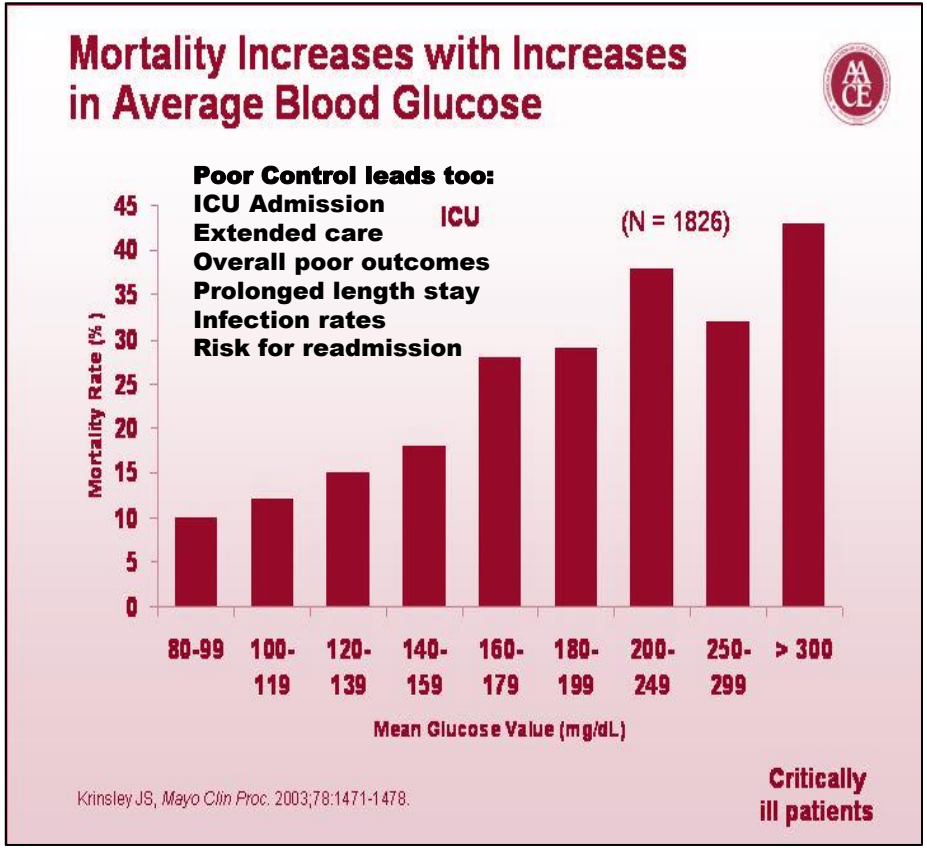
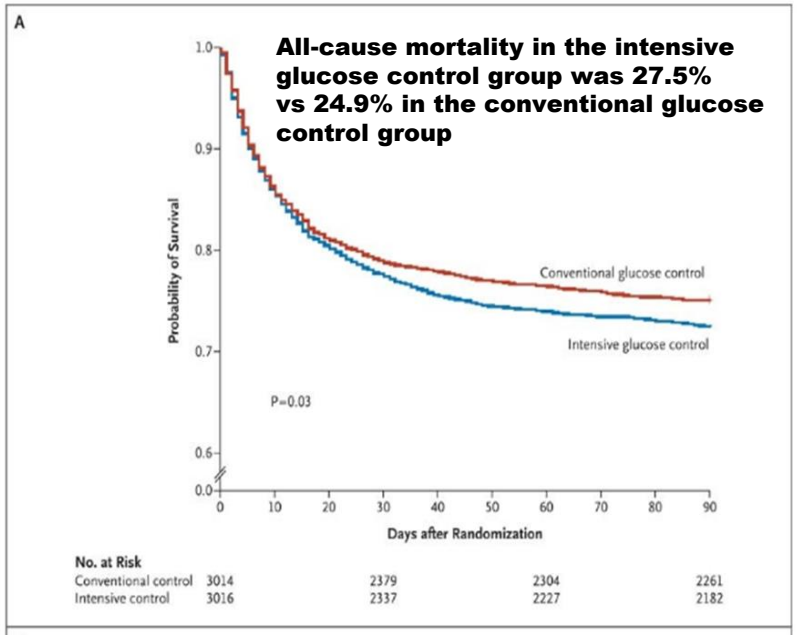
Importance of Inpatient DM Care



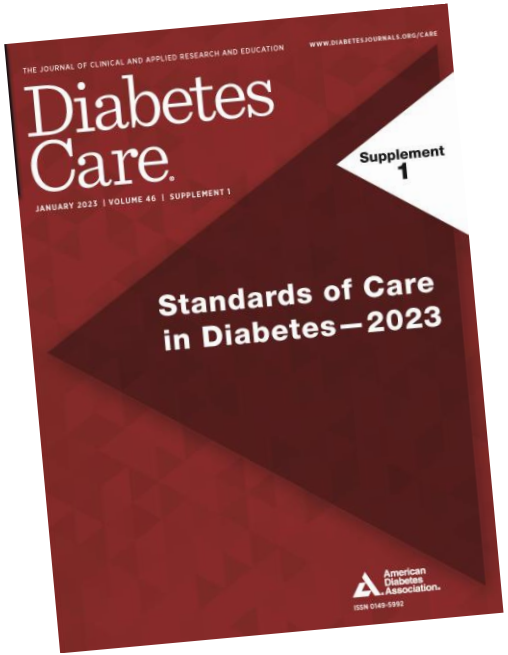
NICE-Sugar



NICE-SUGAR (2009). Intensive versus Conventional Glucose Control in Critically Ill Patients. *New England Journal of Medicine, 360*, 1283-1297.

ICU tight glycemic control increased mortality.

Inpatient Diabetes Standards of Care and Best Practice for Glucose Management



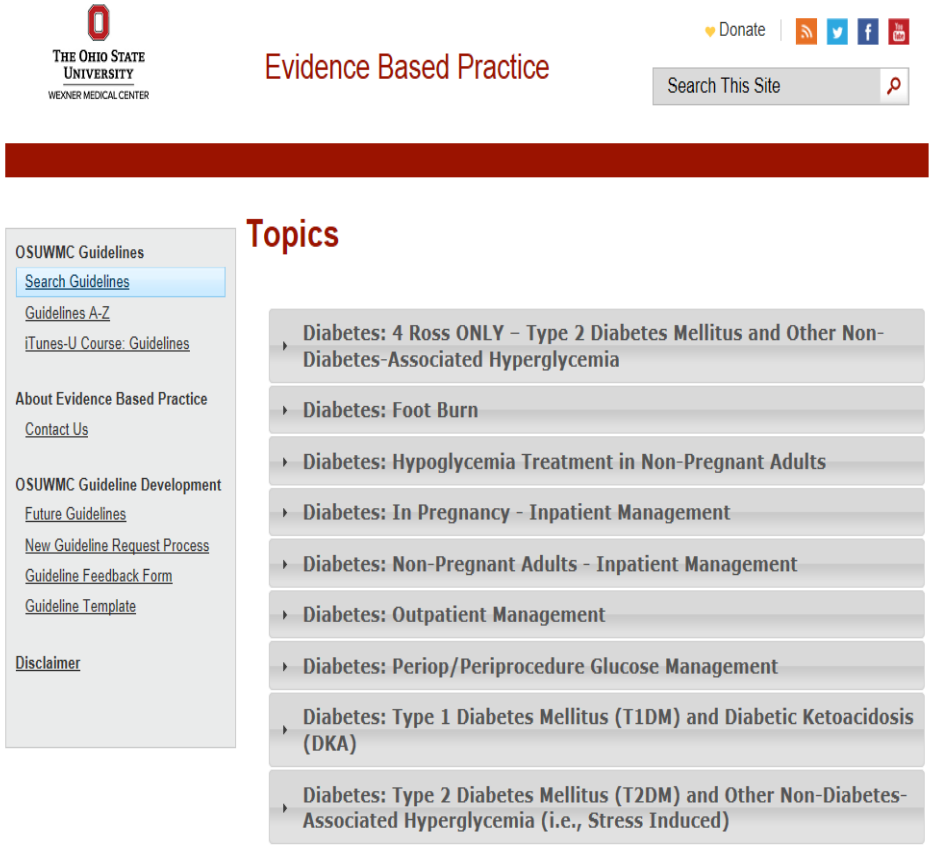
Diabetes Care Volume 46, Supplement 1, January 2023

16. Diabetes Care in the Hospital: *Standards of Care in Diabetes—2023*

Diabetes Care 2023;46(Suppl. 1):S267–S278 | https://doi.org/10.2337/dc23-S016

"High-quality hospital care for diabetes requires standards for care delivery, which are best implemented using a structured order sets and quality improvement strategies for process improvement."

DM teams with specialist and educators in hospital can decrease LOS and improve outcomes



Example:

Diabetes Guidelines Streamline Standardize Consistency

And Hyperlinked IHIS MAR

Inpatient BG targets and recommended therapy to treat hyperglycemia – Insulin

Table 1.1—Summary of ADA/AACE Recommendations for Management of Hyperglycemia among Hospitalized Patients

	Critically ill	Noncritically ill
Blood glucose target	■ 140 to 180 mg/dL (7.8 to 10.0 mmol/L)	■ Premeal: <140 mg/dL (<7.8 mmol/L)* ■ Random: <180 mg/dL (<10.0 mmol/L)*
Preferred treatment regimen	■ Intravenous insulin infusion of regular insulin ■ Use validated insulin infusion protocol ■ Frequently monitor blood glucose to minimize hypoglycemia	■ Scheduled subcutaneous administration of insulin, with basal, nutritional, and correction components ■ Prolonged therapy with sliding-scale insulin as the sole regimen is discouraged ■ Noninsulin antihyperglycemic agents are not appropriate for most hospitalized patients who require therapy for hyperglycemia

*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 terminally ill patients or those with severe comorbidities

Moghissi, E., Inzucchi, S. (2016). Evolution of Glycemic Control in the Hospital Setting. *Managing Diabetes and Hyperglycemia in the Hospital Setting,*

Ex: Insulin Management Inpatient

What would you do?

Admitted for CP and had Acute NSTEMI
Blood sugar is 300 mg/dL.

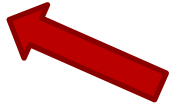
A. Restart home regimen of metformin and glipizide
B. Start Insulin drip
C. Start SQ Basal Bolus Insulin
D. Hold Diabetes meds for now

Case 1

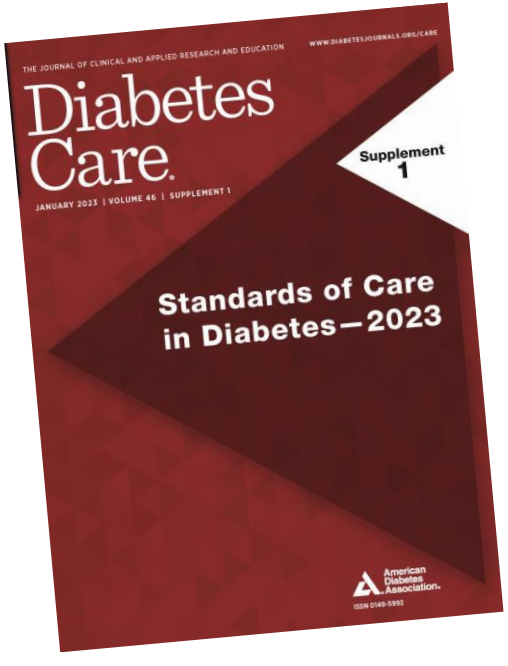
Orals vs Insulin Inpatient

Non-Pharmacy Standard of Care All	Pharmacologic agents
Diabetes Education	α-Glucosidase inhibitors
Lifestyle Change	Biguanides
Exercise	Sulfonylureas
Nutrition Therapy	Meglitinides
Monitoring	Thiazolidinediones
Stress Management	DDP-4 inhibitors
Weight Management	GLP-1 injectable
Physical Activity	SGLT – 2 Inhibitor
Sleep	Bile acid sequestrates
Smoking ETOH	Dopamine-2 agonists
Mood Mental Health	Insulin

- Insulin therapy recommended inpatient
- *Resources and information on orals, included for your reference not focus this talk today*
- Metformin not necessarily 1st line anymore now based on cardiorenal protection.



Oral and Insulin Reference



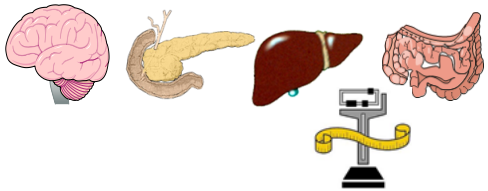
9. Pharmacologic Approaches to Glycemic Treatment: *Standards of Care in Diabetes—2023*

Diabetes Care 2023;46(Suppl. 1):S140–S157 | https://doi.org/10.2337/dc23-S009

10. Cardiovascular Disease and Risk Management: *Standards of Care in Diabetes—2023*

Diabetes Care 2023;46(Suppl. 1):S158–S190 | https://doi.org/10.2337/dc23-S010

Oral Diabetes Medications – Mechanism of Action



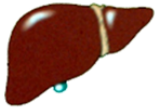
Multiple actions

- **GLP-1 based "incretin" therapies: *GLP-1 analogues* and *DPP4-inhibitors***

Increase insulin secretion (insulin secretagogues):

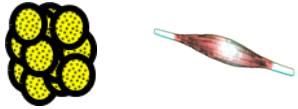
- *Sulfonylureas and meglitinides*

Reduce endogenous glucose production:



- *Biguanides*
- *Bile acid sequestrants (Colesevelam)*

Increase insulin sensitivity:

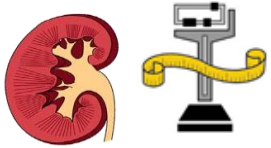


- *Thiazolidinediones*

Decrease GI glucose absorption:

- *Amylin analogue*
- *Alpha-glucosidase inhibitors*

Block renal glucose reabsorption:



- ***SGLT-2 inhibitors***

2008 FDA REQUIRE label indication of reducing CVD events

Composite endpoints !!

MACE *Major Adverse CV Events*
3 point CV Death, Nonfatal MI, Non-fatal Stroke
4 hospitalization unstable angina

Focus GLP SGLT2
DPP4 why
why not ...

GLP-1 Receptor Agonists

GLP: Glucagon-like peptide

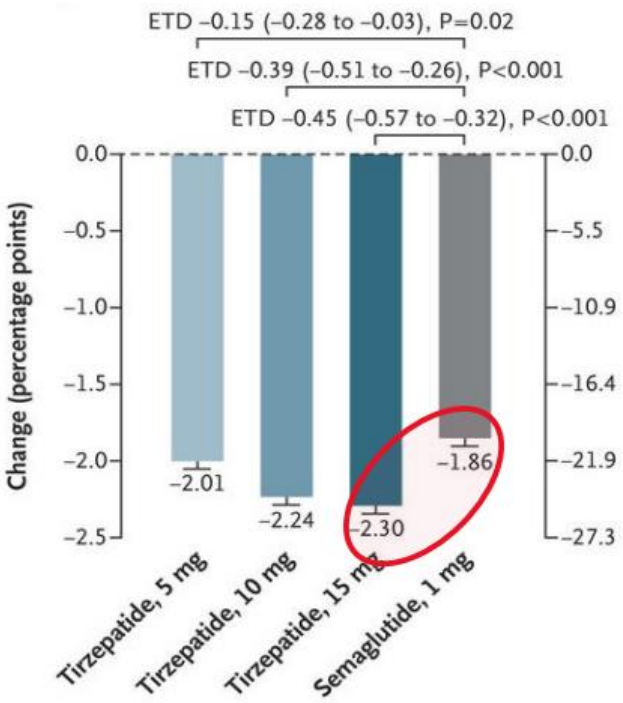
Generic Name	Brand Name	Dose Forms	Dosing Interval	Cautions
Exenatide BID	Byetta	5, 10 µg	BID	Thyroid C-cell tumor warning, advanced CKD, gastroparesis, pancreatitis
Lixisenatide	Lyxumia	10, 20 µg	Daily	
Liraglutide*	Victoza	1.6, 1.2, 1.8 mg	Daily	
Exenatide QW	Bydureon	2 mg	Weekly	
Semaglutide*	Ozempic	0.5, 1.0 mg	Weekly	
	Rybelsus	3, 7, 14 mg PO	Daily	
Dulaglutide*	Trulicity	0.75, 1.5 mg	Weekly	

- No inherent hypoglycemia
- Modest weight 4-9 lbs. and BP reduction
- Nausea/vomiting, usually self-limited
- Lower A1C 0.5 – 1.6%

* Significantly reduce risk CV death, MI, CVA

Tirzepatide - Mounjaro

- GLP-1/GIP analogue injection
- Superior A1C/weight loss/QOL vs. semaglutide 1.0 mg
- Similar tolerability
- No comparisons with semaglutide 2 mg or higher



Change in A1C lowers 1.8 – 2.3%
N=1878, 40 week RCT
Additional 5.5 kg (12 lb.) weight loss vs. semaglutide

GLP: Glucagon-like peptide
GIP: Glucose dependent insulinotropic polypeptide

Frias JP et al. N Engl J Med 2021; 385:503-515.
Tirzepatide versus Semaglutide Once Weekly in Patients with Type 2 Diabetes

SGLT2 Inhibitors

Sodium Glucose Transporter

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Name	Starting Dose	Max Dose	Primary Effect	Cautions
Canagliflozin* (Invokana®)	100 mg daily	300 mg daily	Block renal glucose reabsorption	UG infection fluid/electrolyte euglycemic DKA Amputation? (C)
Empagliflozin* (Jardiance®)	10 mg daily	25 mg daily		
Dapagliflozin* (Farxiga®)	5 mg daily	10 mg daily		
Ertugliflozin (Steglatro®)	5 mg daily	15 mg daily		

- Modest blood pressure, weight reduction 3-4 lbs.
- No hypoglycemia
- Small rise in Cr early but long-term renoprotection

- 1st line HF, CKD, CVD before or with metformin

Check GFR dosing, limited BG lower GFR<45

GLP-1RA or SGLT2i ?

Weight loss in both

No hypoglycemia in either

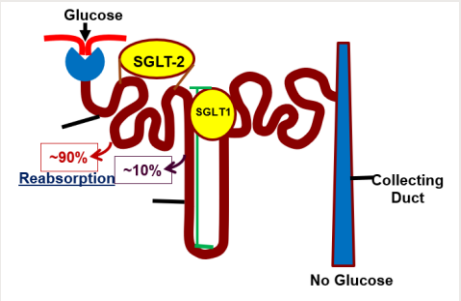
$$

GLP1-RA

- ASCVD, especially stroke benefit
- Modest renal benefit
- Greater A1c reduction

SGLT2i

- ASCVD, HF benefit
- Renal benefit
- Minimal A1c reduction at lower eGFR



GLP- 1 agonists
Patient education

- Most of these medicines are injectable.
- These medicines may cause some weight loss. The most common side effects are nausea, diarrhea, and upset stomach. These side effects often get better after the first few days.
- Hold day of or week prior to surgery, lower risk nausea, vomiting gastric contents.
- This medicine should be taken on an empty stomach at least 30 minutes before first food, drink, or other oral medicines with no more than 4 oz of plain water

SGLT2
Patient education

- Take1 time each day by mouth with or without food.
- These may cause some increased urination and weight loss and improve blood pressure.
- These may reduce cardiovascular disease and chronic kidney disease.
- The major risk is yeast infections.genital infections, and UTI.
- Practice good personal hygiene: wear cotton underwear; change out of wet clothes; do not wear tight clothing; always wipe from front to back; and change tampons, pads, and panty liners often.
- Hold 3 dy prior surgery lower risk ketoacidosis
- Inform patients and caregivers of the signs and symptoms of acidosis, such as rapid breathing, shortness of breath, abdominal pain, nausea, vomiting, feeling tired, or mental status changes, and seek medical attention immediately if they experience the signs or symptoms

Diabetes Education wexnermedical.osu.edu 23 Oral Diabetes Medicines
DM ed book https://go.osu.edu/pted3577

Table 10.3B—Cardiovascular and cardiorenal outcomes trials of available antihyperglycemic medications completed after the issuance of the FDA 2008 guidelines: GLP-1 receptor agonists

	ELIXA (208) (*n* = 6,068)	LEADER (203) (*n* = 9,340)	SUSTAIN-6 (204)* (*n* = 3,297)	EXSCEL (209) (*n* = 14,752)	REWIND (207) (*n* = 9,901)	PIONEER-6 (205) (*n* = 3,183)
Intervention	Lixisenatide/placebo	Liraglutide/placebo	Semaglutide s.c. injection/placebo	Exenatide QW/ placebo	Dulaglutide/ placebo	Semaglutide oral/ placebo
Main inclusion criteria	Type 2 diabetes and history of ACS (<180 days)	Type 2 diabetes and preexisting CVD, CKD, or HF at ≥50 years of age or CV risk at ≥60 years of age	Type 2 diabetes and preexisting CVD, HF, or CKD at ≥50 years of age or CV risk at ≥60 years of age	Type 2 diabetes with or without preexisting CVD	Type 2 diabetes and prior ASCVD event or risk factors for ASCVD	Type 2 diabetes and high CV risk (age of ≥50 years with established CVD or CKD, or age of ≥60 years with CV risk factors only)
A1C inclusion criteria (%)	5.5–11.0	≥7.0	≥7.0	6.5–10.0	≤9.5	None
Age (years)†	60.3	64.3	64.6	62	66.2	66
Race (% White)	75.2	77.5	83.0	75.8	75.7	72.3
Sex (% male)	69.3	64.3	60.7	62	53.7	68.4
Diabetes duration (years)†	9.3	12.8	13.9	12	10.5	14.9
Median follow-up (years)	2.1	3.8	2.1	3.2	5.4	1.3
Statin use (%)	93	72	73	74	66	85.2 (all lipid-lowering)
Metformin use (%)	66	76	73	77	81	77.4
Prior CVD/CHF (%)	100/22	81/18	60/24	73.1/16.2	32/9	84.7/12.2
Mean baseline A1C (%)	7.7	8.7	8.7	8.0	7.4	8.2
Mean difference in A1C between groups at end of treatment (%)	−0.3‡^	−0.4‡	−0.7 or −1.0^	−0.53‡^	−0.61‡	−0.7
Year started/reported	2010/2015	2010/2016	2013/2016	2010/2017	2011/2019	2017/2019
Primary outcome§	4-point MACE 1.02 (0.89–1.17)	3-point MACE 0.87 (0.78–0.97)	3-point MACE 0.74 (0.58–0.95)	3-point MACE 0.91 (0.83–1.00)	3-point MACE 0.88 (0.79–0.99)	3-point MACE 0.79 (0.57–1.11)

Continued on p. S175

Table 10.3B—Cardiovascular and cardiorenal outcomes trials of GLP-1 and SGLT2

UpToDate ….

Table 9.3—Median monthly (30-day) AWP and NADAC of maximum approved daily dose of noninsulin glucose-lowering agents in the U.S.

Class	Compound(s)	Dosage strength/ product (if applicable)	Median AWP (min, max)†	Median NADAC (min, max)†	Maximum approved daily dose*
Biguanides	• Metformin	850 mg (IR)	$106 ($5, $189)	$2	2,550 mg
		1,000 mg (IR)	$87 ($3, $144)	$2	2,000 mg
		1,000 mg (ER)	$242 ($242, $7,214)	$32 ($32, $160)	2,000 mg
Sulfonylureas (2nd generation)	• Glimepiride	4 mg	$74 ($71, $198)	$3	8 mg
	• Glipizide	10 mg (IR)	$70 ($67, $91)	$6	40 mg
		10 mg (XL/ER)	$48 ($46, $48)	$11	20 mg
	• Glyburide	6 mg (micronized)	$52 ($48, $71)	$12	12 mg
		5 mg	$79 ($63, $93)	$9	20 mg
Thiazolidinedione	• Pioglitazone	45 mg	$345 ($7, $349)	$4	45 mg
α-Glucosidase inhibitors	• Acarbose	100 mg	$106 ($104, $106)	$29	300 mg
	• Miglitol	100 mg	$241 ($241, $346)	NA	300 mg
Meglitinides	• Nateglinide	120 mg	$155	$27	360 mg
	• Repaglinide	2 mg	$878 ($58, $897)	$31	16 mg
DPP-4 inhibitors	• Alogliptin	25 mg	$234	$154	25 mg
	• Saxagliptin	5 mg	$565	$452	5 mg
	• Linagliptin	5 mg	$606	$485	5 mg
	• Sitagliptin	100 mg	$626	$500	100 mg
SGLT2 inhibitors	• Ertugliflozin	15 mg	$390	$312	15 mg
	• Dapagliflozin	10 mg	$659	$527	10 mg
	• Canagliflozin	300 mg	$684	$548	300 mg
	• Empagliflozin	25 mg	$685	$547	25 mg
GLP-1 RAs	• Exenatide (extended release)	2 mg powder for suspension or pen	$936	$726	2 mg**
	• Exenatide	10 μg pen	$961	$770	20 μg
	• Dulaglutide	4.5 mg mL pen	$1,064	$852	4.5 mg**
	• Semaglutide	1 mg pen	$1,070	$858	2 mg**
		14 mg (tablet)	$1,070	$858	14 mg
	• Liraglutide	1.8 mg pen	$1,278	$1,022	1.8 mg
	• Lixisenatide	20 μg pen	$814	NA	20 μg
GLP-1/GIP dual agonist	• Tirzepatide	15 mg pen	$1,169	$935	15 mg**
Bile acid sequestrant	• Colesevelam	625 mg tabs	$711 ($674, $712)	$83	3.75 g
		3.75 g suspension	$674 ($673, $675)	$177	3.75 g
Dopamine-2 agonist	• Bromocriptine	0.8 mg	$1,118	$899	4.8 mg
Amylin mimetic	• Pramlintide	120 μg pen	$2,783	NA	120 μg/injection††

AWP, average wholesale price; DPP-4, dipeptidyl peptidase 4; ER and XL, extended release; GIP, glucose-dependent insulinotropic polypeptide; GLP-1 RA, glucagon-like peptide 1 receptor agonist; IR, immediate release; max, maximum; min, minimum; NA, data not available; NADAC, National Average Drug Acquisition Cost; SGLT2, sodium-glucose cotransporter 2. †Calculated for 30-day supply (AWP [72] or NADAC [73] unit price × number of doses required to provide maximum approved daily dose × 30 days); median AWP or NADAC listed alone when only one product and/or price. *Utilized to calculate median AWP and NADAC (min, max); generic prices used, if available commercially. **Administered once weekly. ††AWP and NADAC calculated based on 120 μg three times daily.

Review ADA section 9 Pharma Tx

Summary of oral glucose-lowering agents.

Beyond scope this talk review orals but included reference.

Median monthly cost, options and doses.

Metformin often but no longer only 1st line

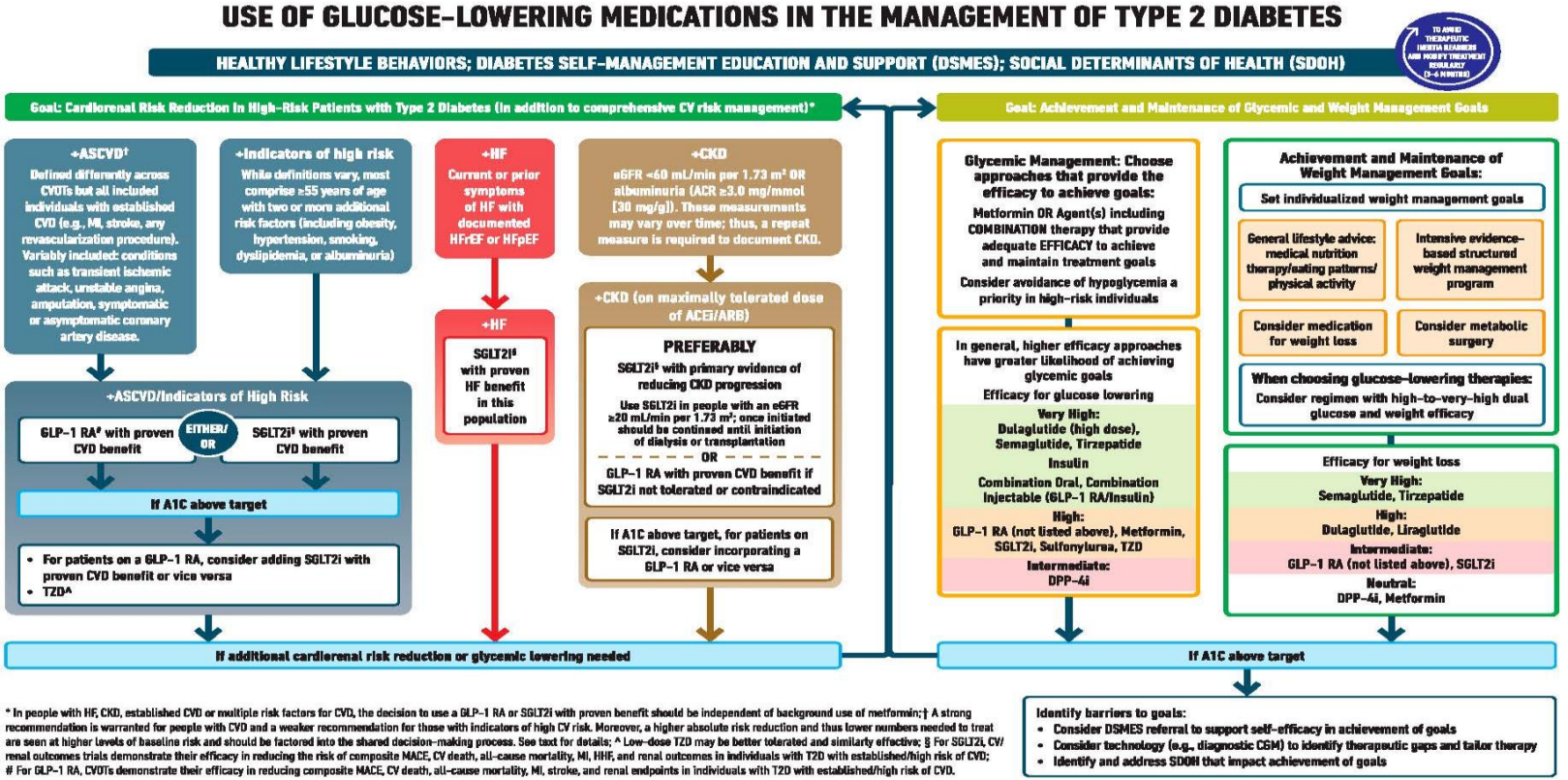
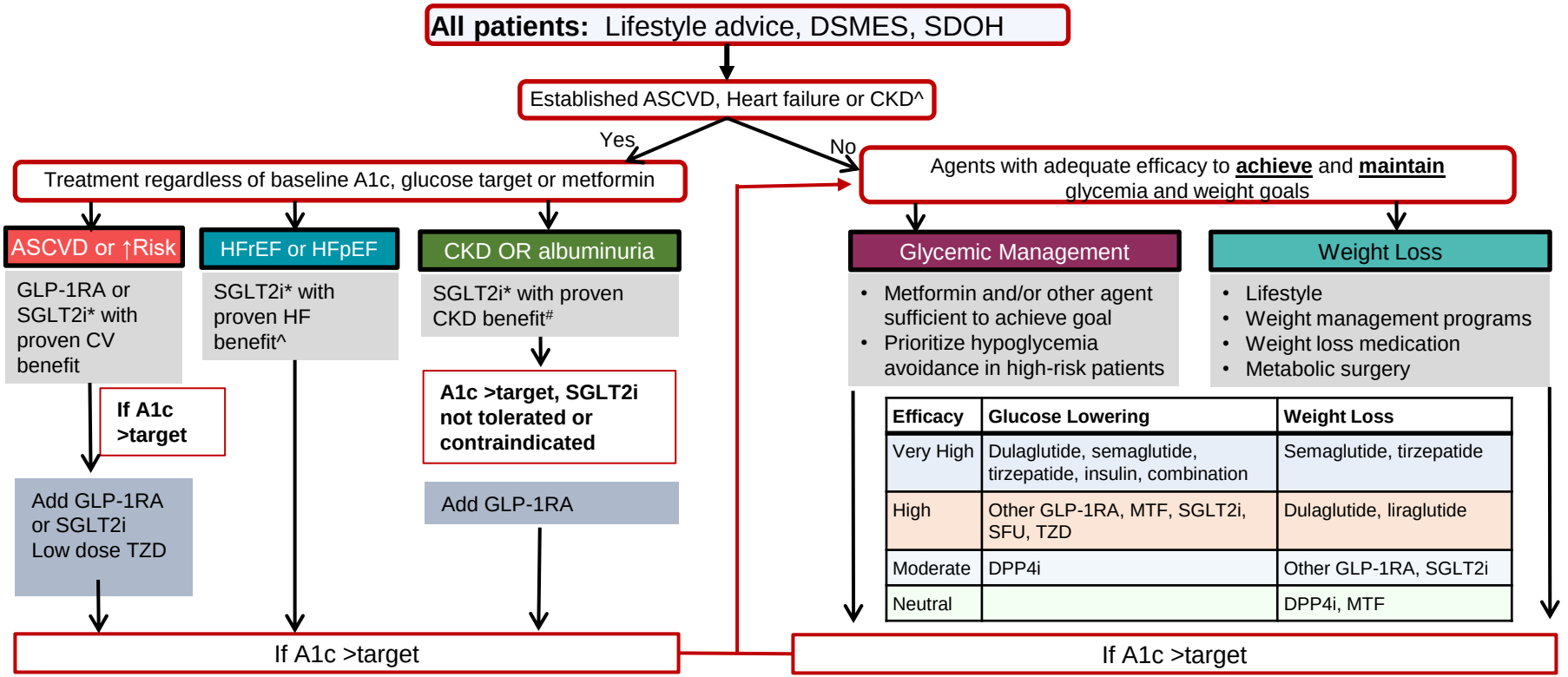


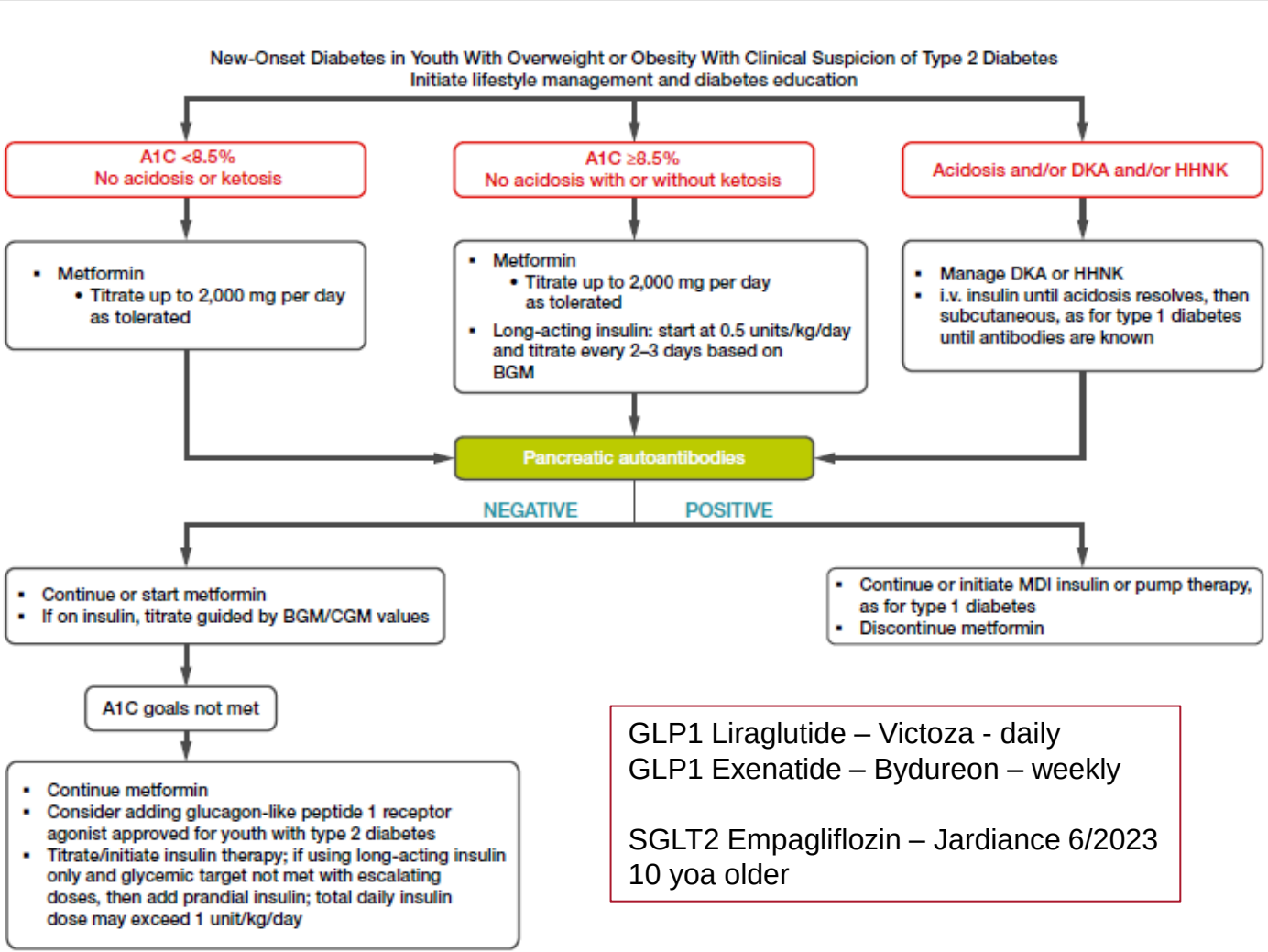
Figure 9.3—Use of glucose-lowering medications in the management of type 2 diabetes. ACEi, angiotensin-converting enzyme inhibitor; ACR, albumin-to-creatinine ratio; ARB, angiotensin receptor blocker; ASCVD, atherosclerotic cardiovascular disease; CGM, continuous glucose monitoring; CKD, chronic kidney disease; CV, cardiovascular; CVD, cardiovascular disease; CVOT, cardiovascular outcomes trial; DPP-4i, dipeptidyl peptidase 4 inhibitor; eGFR, estimated glomerular filtration rate; GLP-1 RA, glucagon-like peptide 1 receptor agonist; HF, heart failure; HFpEF, heart failure with preserved ejection fraction; HFrEF, heart failure with reduced ejection fraction; HHF, hospitalization for heart failure; MACE, major adverse cardiovascular events; MI, myocardial infarction; SDOH, social determinants of health; SGLT2i, sodium-glucose cotransporter 2 inhibitor; T2D, type 2 diabetes; TZD, thiazolidinedione. Adapted from Davies et al. (45).

Standards of Medical Care in Diabetes 2023

Pharmacologic Management, ADA/EASD Consensus 2022



Davies et al. Diabetologia. 2022;65(12):1925-1966. doi: 10.1007/s00125-022-05787-2.



GLP1 Liraglutide – Victoza - daily
GLP1 Exenatide – Bydureon – weekly

SGLT2 Empagliflozin – Jardiance 6/2023
10 yoa older

Figure 14.1—New-Onset Diabetes in Youth With Overweight or Obesity With Clinical Suspicion of Type 2 Diabetes

Children & Adolescents: *Standards of Care in Diabetes - 2023*. *Diabetes Care* 2023;46(Suppl. 1): S230-S253

American Diabetes Association.
Connected for Life

Final Oral Summary/Reference

Table 9.2—Medications for lowering glucose, summary of characteristics

	Efficacy[1]	Hypoglycemia	Weight change[2]	CV effects		Renal effects		Oral/SQ	Cost	Clinical considerations
				Effect on MACE	HF	Progression of DKD	Dosing/use considerations*			
Metformin	High	No	Neutral (potential for modest loss)	Potential benefit	Neutral	Neutral	• Contraindicated with eGFR <30 mL/min per 1.73 m²	Oral	Low	• GI side effects common; to mitigate GI side effects, consider slow dose titration, extended release formulations, and administration with food • Potential for vitamin B12 deficiency; monitor at regular intervals
SGLT2 inhibitors	Intermediate to high	No	Loss (intermediate)	Benefit: canagliflozin, empagliflozin	Benefit: canagliflozin, dapagliflozin, empagliflozin, ertugliflozin	Benefit: canagliflozin, dapagliflozin, empagliflozin	• See labels for renal dose considerations of individual agents • Glucose-lowering effect is lower for SGLT2 inhibitors at lower eGFR	Oral	High	• DKA risk, rare in T2DM: discontinue, evaluate, and treat promptly if suspected; be aware of predisposing risk factors and clinical presentation (including euglycemic DKA); discontinue before scheduled surgery (e.g., 3–4 days), during critical illness, or during prolonged fasting to mitigate potential risk • Increased risk of genital mycotic infections • Necrotizing fasciitis of the perineum (Fournier gangrene), rare reports: institute prompt treatment if suspected • Attention to volume status, blood pressure; adjust other volume-contracting agents as applicable
GLP-1 RAs	High to very high	No	Loss (intermediate to very high)	Benefit: dulaglutide, liraglutide, semaglutide (SQ) Neutral: exenatide once weekly, lixisenatide	Neutral	Benefit for renal endpoints in CVOTs, driven by albuminuria outcomes: dulaglutide, liraglutide, semaglutide (SQ)	• See labels for renal dose considerations of individual agents • No dose adjustment for dulaglutide, liraglutide, semaglutide • Monitor renal function when initiating or escalating doses in patients with renal impairment reporting severe adverse GI reactions	SQ; oral (semaglutide)	High	• Risk of thyroid C-cell tumors in rodents; human relevance not determined (liraglutide, dulaglutide, exenatide extended release, semaglutide) • Counsel patients on potential for GI side effects and their typically temporary nature; provide guidance on dietary modifications to mitigate GI side effects (reduction in meal size, mindful eating practices [e.g., stop eating once full], decreasing intake of high-fat or spicy food); consider slower dose titration for patients experiencing GI challenges • Pancreatitis has been reported in clinical trials but causality has not been established. Discontinue if pancreatitis is suspected • Evaluate for gallbladder disease if cholelithiasis or cholecystitis is suspected
GIP and GLP-1 RA	Very high	No	Loss (very high)	Under investigation	Under investigation	Under investigation	• See label for renal dose considerations • No dose adjustment • Monitor renal function when initiating or escalating doses in patients with renal impairment reporting severe adverse GI reactions	SQ	High	• Risk of thyroid C-cell tumors in rodents; human relevance not determined • Counsel patients on potential for GI side effects and their typically temporary nature; provide guidance on dietary modifications to mitigate GI side effects (reduction in meal size, mindful eating practices [e.g., stop eating once full], decreasing intake of high-fat or spicy food); consider slower dose titration for patients experiencing GI challenges • Pancreatitis has been reported in clinical trials but causality has not been established. Discontinue if pancreatitis is suspected • Evaluate for gallbladder disease if cholelithiasis or cholecystitis is suspected
DPP-4 inhibitors	Intermediate	No	Neutral	Neutral	Neutral (potential risk, saxagliptin)	Neutral	• Renal dose adjustment required (sitagliptin, saxagliptin, alogliptin); can be used in renal impairment • No dose adjustment required for linagliptin	Oral	High	• Pancreatitis has been reported in clinical trials but causality has not been established. Discontinue if pancreatitis is suspected • Joint pain • Bullous pemphigoid (postmarketing): discontinue if suspected
Thiazolidinediones	High	No	Gain	Potential benefit: pioglitazone	Increased risk	Neutral	• No dose adjustment required • Generally not recommended in renal impairment due to potential for fluid retention	Oral	Low	• Congestive HF (pioglitazone, rosiglitazone) • Fluid retention (edema; heart failure) • Benefit in NASH • Risk of bone fractures • Weight gain: consider lower doses to mitigate weight gain and edema
Sulfonylureas (2nd generation)	High	Yes	Gain	Neutral	Neutral	Neutral	• Glyburide: generally not recommended in chronic kidney disease • Glipizide and glimepiride: initiate conservatively to avoid hypoglycemia	Oral	Low	• FDA Special Warning on increased risk of CV mortality based on studies of an older sulfonylurea (tolbutamide); glimepiride shown to be CV safe (see text) • Use with caution in persons at risk for hypoglycemia
Insulin Human	High to very high	Yes	Gain	Neutral	Neutral	Neutral	• Lower insulin doses required with a decrease in eGFR; titrate per clinical response	SQ; inhaled	Low (SQ)	• Injection site reactions • Higher risk of hypoglycemia with human insulin (NPH or premixed formulations) vs. analogs
Insulin Analogs								SQ	High	

CV, cardiovascular; CVOT, cardiovascular outcomes trial; DKA, diabetic ketoacidosis; DKD, diabetic kidney disease; DPP-4, dipeptidyl peptidase 4; eGFR, estimated glomerular filtration rate; FDA, U.S. Food and Drug Administration; GI, gastrointestinal; GIP, gastric inhibitory polypeptide; GLP-1 RA, glucagon-like peptide 1 receptor agonist; HF, heart failure; NASH, nonalcoholic steatohepatitis; MACE, major adverse cardiovascular events; SGLT2, sodium–glucose cotransporter 2; SQ, subcutaneous; T2DM, type 2 diabetes mellitus. *For agent-specific dosing recommendations, please refer to manufacturers' prescribing information. [1]Tsapas et al. (62). [2]Tsapas et al. (114). Reprinted from Davies et al. (45).

Inpatient Management of Glucose Control

- Oral and non-insulin injectable therapy
  - No safety data available for use in hospital setting (oral intake varies, n/v, renal clearance)
  - Continuation of home therapy in select patients
    - Typically stop oral diabetes agents in hospital
    - Resuming if potential discharge and pt stable

- Insulin therapy preferred for majority of patients initiated for BG >180 mg/dL
  - IV infusion preferred for critical care patients
  - SubQ insulin (including basal, nutritional, and correction doses) preferred for general medicine patients – may need reduction in home total daily dose 20-50%.

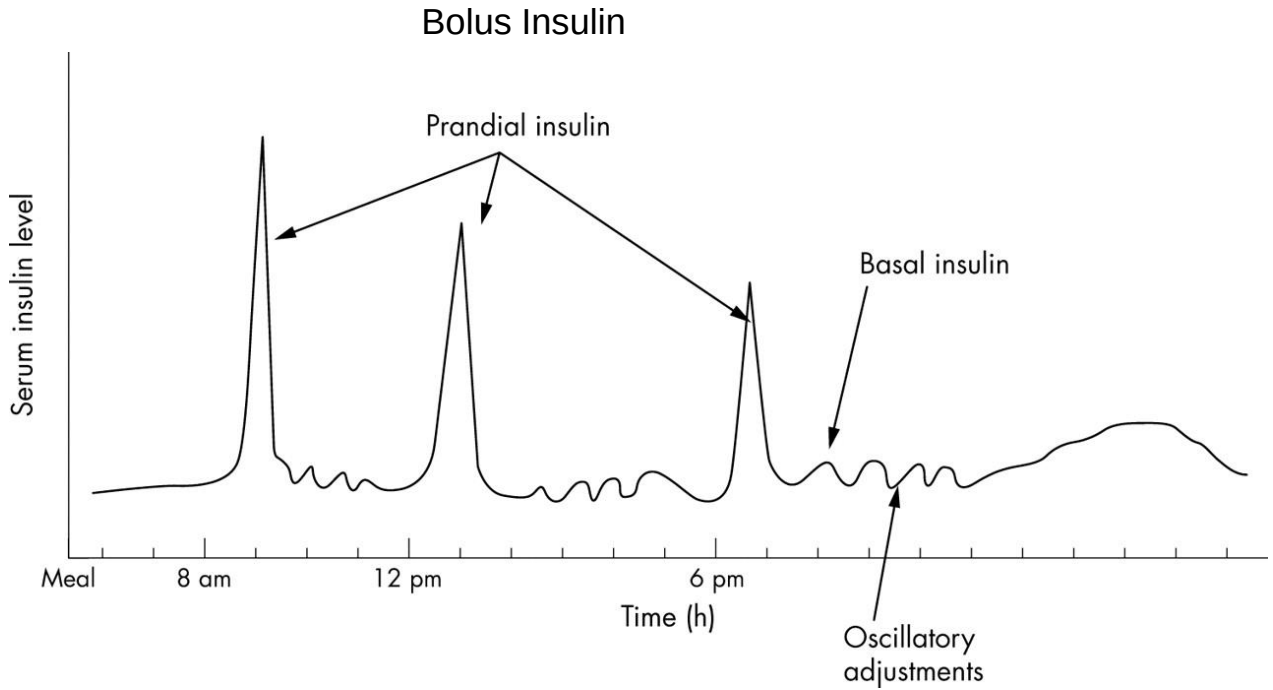
- GLP1 injectables not used inpatient not on formulary and can cause nausea and vomiting and with limited oral intake.
- SGLT2 some evidence beneficial inpatient T2DM CHF – Cardiology – weigh risk / benefit

Slide adopted OSUWMC Med Safety 2012
Standards of Medical Care in Diabetes 2023

25

Insulin therapy preferred for majority of inpatients :

Representation of variation in serum insulin concentration during a 24 hour period to illustrate components of insulin secretion/delivery.



Hindmarsh P C Arch Dis Child 2005;90:1144-1147

High Risk Medication - *Insulin*

- Definition
  - “High-risk drugs involved in a high percentage of medication errors and/or other adverse outcomes.”
- Rationale/risk
  - Cause profound hypoglycemia accompanied by EKG changes and arrhythmias
  - Lethal if given in substantially excessive doses or in place of other medications
- Common causes of inpatient hypoglycemia:
  - Acute kidney injury, decreasing insulin clearance
  - Prescribing errors
  - Failure to respond to nutritional interruption
  - Failure to manage a prior hypoglycemic event
- Recommendations
  - Use electronic health record (EMR) protocols for insulin administration
  - Insulin order sets and guidelines
  - Insulin dosing algorithms in the EMR
  - Evaluate hypoglycemia trends and address systemic issues - committees

Slide adopted OSUWMC Med Safety 2012
Standards of Medical Care in Diabetes 2023

Table 9.4—Median cost of insulin products in the U.S. calculated as AWP (72) and NADAC (73) per 1,000 units of specified dosage form/product

Insulins	Compounds	Dosage form/product	Median AWP (min, max)*	Median NADAC*
Rapid-acting	• Lispro follow-on product	U-100 vial	$118 ($118, $157)	$94
		U-100 prefilled pen	$151	$121
	• Lispro	U-100 vial	$99†	$79†
		U-100 cartridge	$408	$326
		U-100 prefilled pen	$127†	$102†
		U-200 prefilled pen	$424	$339
	• Lispro-aabc	U-100 vial	$330	$261
		U-100 prefilled pen	$424	$339
		U-200 prefilled pen	$424	NA
	• Glulisine	U-100 vial	$341	$272
		U-100 prefilled pen	$439	$351
	• Aspart	U-100 vial	$174†	$140†
		U-100 cartridge	$215†	$172†
		U-100 prefilled pen	$224†	$180†
	• Aspart ("faster acting product")	U-100 vial	$347	$277
		U-100 cartridge	$430	$344
		U-100 prefilled pen	$447	$357
	• Inhaled insulin	Inhalation cartridges	$1,418	NA
Short-acting	• Human regular	U-100 vial	$165††	$132††
		U-100 prefilled pen	$208	$166
Intermediate-acting	• Human NPH	U-100 vial	$165††	$132††
		U-100 prefilled pen	$208	$168
Concentrated human regular insulin	• U-500 human regular insulin	U-500 vial	$178	$142
		U-500 prefilled pen	$230	$184
Long-acting	• Glargine follow-on products	U-100 prefilled pen	$261 ($118, $323)	$209 ($209, $258)
		U-100 vial	$118 ($118, $323)	$95
	• Glargine	U-100 vial; U-100 prefilled pen	$136†	$109†
		U-300 prefilled pen	$346	$277
	• Detemir	U-100 vial; U-100 prefilled pen	$370	$296
	• Degludec	U-100 vial; U-100 prefilled pen; U-200 prefilled pen	$407	$326
Premixed insulin products	• NPH/regular 70/30	U-100 vial	$165††	$133††
		U-100 prefilled pen	$208	$167
	• Lispro 50/50	U-100 vial	$342	$274
		U-100 prefilled pen	$424	$339
	• Lispro 75/25	U-100 vial	$342	$273
		U-100 prefilled pen	$127†	$103†
	• Aspart 70/30	U-100 vial	$180†	$146†
		U-100 prefilled pen	$224†	$178†
Premixed insulin/GLP-1 RA products	• Glargine/Lixisenatide	100/33 μg prefilled pen	$646	$517
	• Degludec/Liraglutide	100/3.6 μg prefilled pen	$944	$760

AWP, average wholesale price; GLP-1 RA, glucagon-like peptide 1 receptor agonist; NA, data not available; NADAC, National Average Drug Acquisition Cost. *AWP or NADAC calculated as in **Table 9.3**. †Generic prices used when available. ††AWP and NADAC data presented do not include vials of regular human insulin and NPH available at Walmart for approximately $25/vial; median listed alone when only one product and/or price.

Review ADA section 9 Pharma Tx

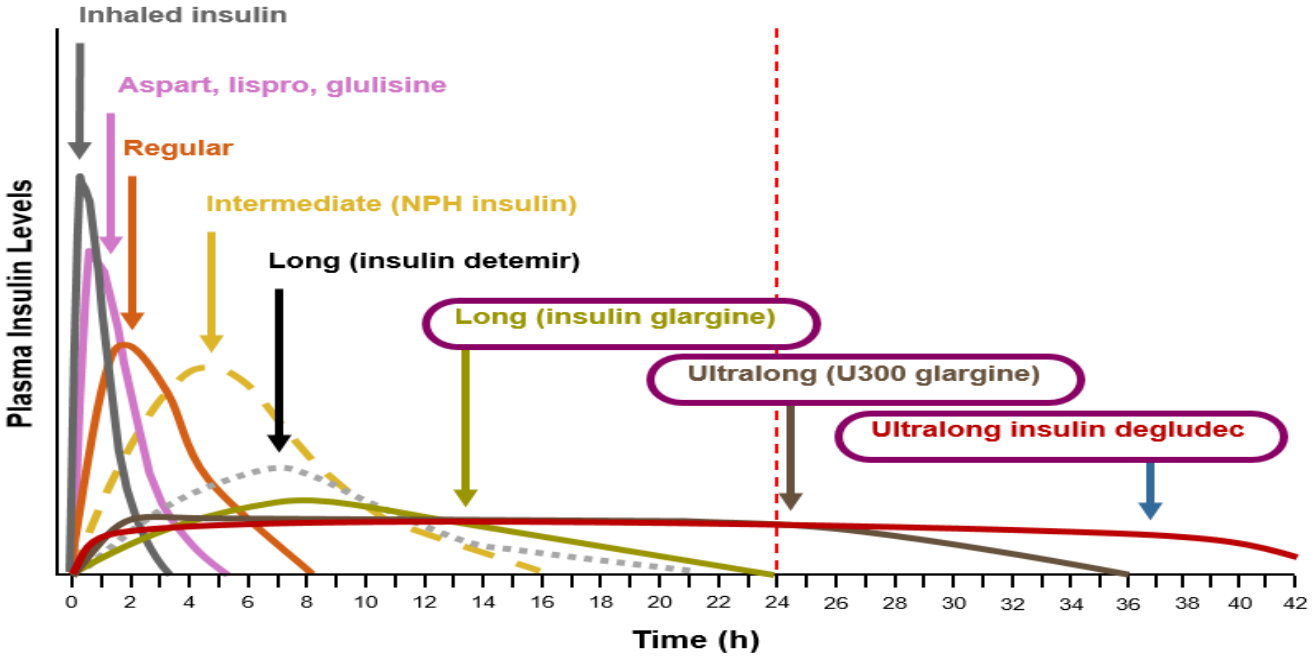
Reference for all Insulin options

Median monthly cost, and options to Rx.

Insulin Types

Types	Formulations
Bolus - Rapid Acting	Aspart-Novolog, Glulisine-Apidra Lispro-Humalog U100&U200, Admelog
Ultra –Rapid Acting Ultra –Rapid Acting- Inhaled	Aspart-Fiasp; Lispro-Lyumjev Afreeza (no COPD,Asthma, Smoke, need PFTs)
Bolus - Short Acting	Regular
Basal Insulin – Long Acting Intermediate Acting	Glargine U100-Lantus; Basaglar; Semglee Glargine U300-Toujeo Detemir-Levemir Degludec –Tresiba U100&U200 NPH
Pre – Mixed NPH/Regular Based NPL Based/Lispro/Humalog NPH/Aspart/Novolog Degludec/Novolog Ryzodeg	 70/30 75/25, 50/50 70/30 70/30
Concentrations	U-100; U-200, U-300**,** U-500 specialist Use cautiously inpatient – follow a guideline and specialist consult best practice

Insulin Pharmacology



PK = pharmacokinetic; NPH = neutral protamine Hagedorn.

Adapted from Hirsch IB. *NEJM*. 2005;352:174-183. Flood TM. *J Fam Pract*. 2007;56(suppl 1):S1-S12. Becker RH, et al. *Diabetes Care*. 2015;38:637-643. http://www.pdr.net/full-prescribing-information/afrezza?druglabelid=3540. Accessed April 5, 2015. Hompesch M, et al. *Clin Ther*. 2014;36(4):507-515. Adapted K.Wyne 2-2017

5 columns= greater precision

Discrete increments

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	Run infusion at **50%** of current rate	**Decrease** infusion by 1 unit/hr	No Change	**Increase** infusion by 0.5 unit/hr	**Increase** infusion by 1 unit/hr	**Increase** infusion by 2 unit/hr
120-150 mg/dL **OPTIMAL**	Run infusion at **25%** of current rate[2]	Run infusion at **50%** of current rate	Run infusion at **75%** of current rate	No Change	No Change	**Increase** infusion by 1 unit/hr
80-120 mg/dL	**Stop the infusion,** contact the prescriber and recheck glucose in 15 minutes	Run infusion at **10%** of current rate; consider contacting prescriber	Run infusion at **25%** of current rate[2]	Run infusion at **50%** of current rate	Run infusion at **75%** of current rate[3]	No 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.

Determine Insulin Adjustments

- Change in BG
- Direction of change in BG
- Current BG
- Current infusion rate

Example

IV insulin Infusion Guideline

Streamline
Standardize
Consistency

Can also include fluid replacement parameters

Example: Guide to Inpatient Insulin Management

Basal Insulin

- Long-acting insulin
- NPH
- Continuous SQ rapid acting insulin (pump)
- IV insulin drip

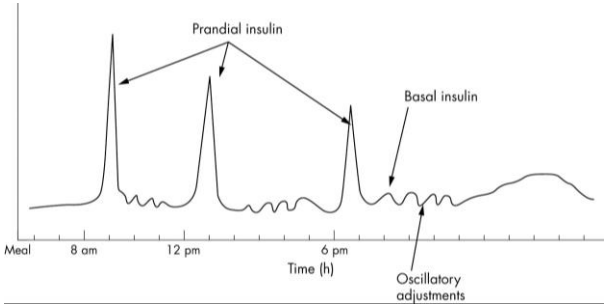
Prandial Insulin

- Rapid-acting insulin
  - (High) 1 unit for every 5 g CHO
  - (STD) 1 unit for every 10 g CHO
  - (Low) 1 unit for every 20 g CHO
- Regular insulin (tube feeds)

Correction/Supplemental Insulin

- Rapid-acting insulin
  - (High) 1 unit for every 25 mg/dl BG >150
  - (STD) 1 unit for every 50 mg/dl BG >150
  - (Low) 1 unit for every 100 mg/dl BG >150
- IV insulin drip

Standard:
150-200 = 1 unit
201-250 = 2 units
251-300 = 3 units
301 -350 = 4 units



Summary of Inpatient Insulin Pitfalls:

- Stopping the infusion without basal insulin coverage
- Failure to restart the infusion following recovery from hypoglycemia
- Stopping the infusion before stable infusion rate is achieved
- T1DM patients should *never* go without basal insulin leads to *iatrogenic* DKA
- In general, DO NOT hold basal insulin even with procedures
- Avoid Regular sliding scale monotherapy in most patients, unless NPO.
- Insulin pens “For Single patient use only”

What would you do?

Admitted for CP and had Acute NSTEMI
Blood sugar is 300 mg/dL.

A. Restart home regimen of metformin and glipizide
B. Start Insulin drip
C. Start SQ Basal Bolus Insulin
D. Hold Diabetes meds for now

Answer:
B. Start Insulin drip acute ill, insulin tx of choice inpatient

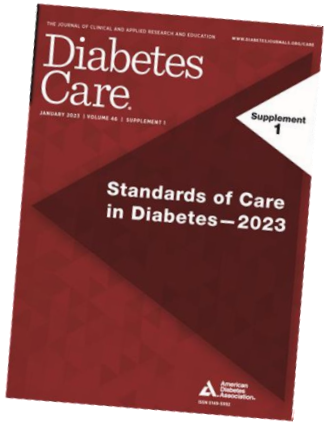
D/C plan depends on hospital course and A1C. Likely will need insulin at discharge.

Case 1- the plan:

Ex: Insulin Management Inpatient

Common challenges of DM care in the hospital

- Hypoglycemia
- Steroid induced hyperglycemia
- DKA/HHS/Euglycemic DKA
- Nutrition Tube Feed, TPN
- NPO, Perioperative Care
- Technology
- Discharge Planning

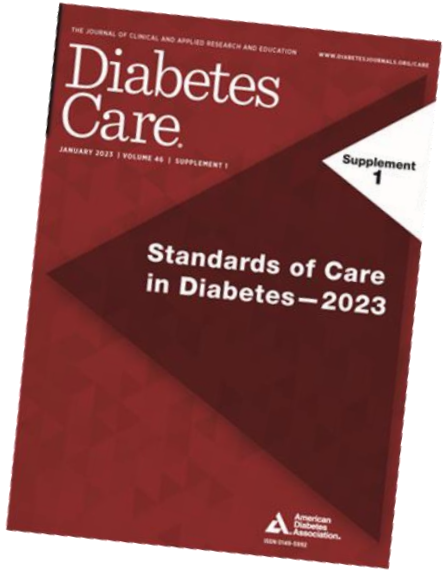


No time great detail
Some cases and OSUWMC examples but more:
Review summarize guidelines
Can get more guidance guidelines
Q&A after 1-1 more specifics

Hypoglycemia in the hospital

6. Glycemic Targets: *Standards of Care in Diabetes—2023*

Diabetes Care 2023;46(Suppl. 1):S97–S110 | https://doi.org/10.2337/dc23-S006



Hypoglycemia

Table 6.4—Classification of hypoglycemia

	Glycemic criteria/description
Level 1	Glucose <70 mg/dL (3.9 mmol/L) and ≥54 mg/dL (3.0 mmol/L)
Level 2	Glucose <54 mg/dL (3.0 mmol/L)
Level 3	A severe event characterized by altered mental and/or physical status requiring assistance for treatment of hypoglycemia

Reprinted from Agiostratidou et al. (74).

Inpatient risk factors:

- Medications: insulin & sulfonylureas
- Illnesses/conditions: AKI/CKD, cirrhosis, sepsis
- Nutrition: decrease in po intake, interruption in TF

Overall goal hypoglycemia prevention

Outpatient greater use of continuous glucose monitor recommended (not yet FDA approved inpatient).

Standards of Medical Care in Diabetes 2023

Table 2: Patients Who Are Alert, Able to Tolerate PO Intake, and with Intact Cognitive Status

BG Level*	Action*			Follow-Up
60-79 mg/dL	**Administer** 15 g oral carbohydrate, choose one: • 4 oz. juice (**NOT OJ**)** or regular soda/pop • 1 tbsp. jelly or sugar • 3 glucose tablets • 1 tube glucose 40% oral gel	**If next meal within 1-2 hrs. also administer** (choose one): • 3 graham crackers • 6 saltine crackers • 8 oz. skim milk	**If next meal > 2 hrs. also administer** (choose one): • ½ sandwich (15 g) • 3 graham crackers with one tbsp. peanut butter	• Recheck BG q15 min following treatment and continue to treat accordingly until ≥ 80 mg/dL • Once BG ≥ 80 mg/dL, recheck BG q1h x 2, then resume POC glucose as previously ordered • Patients who are admitted with hypoglycemia should be monitored at least q4h for a minimum of 24h
	• Consider calling House Officer to report BG if patient experiences recurrent hypoglycemia (≥ 2 distinct events with BG < 70 mg/dL in past 12 hours) • If patient has not received glucose lowering therapy in previous 72 hours, consider treatment only if symptomatic			
45-59 mg/dL	**Administer** 20 g oral carbohydrate, choose one: • 6 oz. juice (**NOT OJ**)** or regular soda/pop • 1 ½ tbsp. jelly or sugar • 4 glucose tablets • 1 ½ tube glucose 40% oral gel	**If next meal within 1-2 hrs. also administer** (choose one): • 3 graham crackers • 6 saltine crackers • 8 oz. skim milk	**If next meal > 2 hrs. also administer** (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	**Administer** 30 g oral carbohydrate, choose one: • 8 oz. juice (**NOT OJ**)** or regular soda/pop • 2 tbsp. jelly or sugar • 6 glucose tablets • 2 tubes glucose 40% oral gel	**If next meal within 1-2 hrs. also administer** (choose one): • 3 graham crackers • 6 saltine crackers • 8 oz. skim milk	**If next meal > 2 hrs. also administer** (choose one): • 1 sandwich (30g) • 3 graham crackers with one tbsp. peanut butter	• Recheck BG q15 min following treatment and continue to treat accordingly until ≥ 80 mg/dL • Once BG ≥ 80 mg/dL, recheck BG q1h x 4, then q 4h for a minimum of 24h
	Call House Officer to report BG and action taken			

*Choose one item from one column based on next mealtime. 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 examples.

**Orange juice not appropriate for patients with renal dysfunction or patients at risk for hypoglycemia.

Hypoglycemia Guideline Example - Eating

Guideline - recommended
Streamline
Standardize
Consistency

- Treatment:
  - If patient can eat,
  - po intake is preferred

Hypoglycemia – Guideline Example – pt not eating

Table 1: Patients Who Are Not Alert or Who Are NPO

BG Level*	Action	Follow-Up
60-79 mg/dL	• Administer 7.5 g Dextrose D50% (15 ml) IV* • **Consider** calling House Officer **if** patient experiences recurrent BG < 70 mg/dL in past 12h	• Recheck BG q 15 min following treatment and continue to treat accordingly until ≥ 80 mg/dL. • Once BG ≥ 80 mg/dL, recheck BG q1h x 2 (*x 4 if <45 mg/dL at onset*), then resume POC glucose as previously ordered. Patients who are admitted with hypoglycemia should be monitored at least q 4h for a minimum of 24h. • If > 4h from initial event and BG ≥ 80 mg/dL for two consecutive readings, may consider reducing IV dextrose.
45-59 mg/dL	• Administer 12.5 g Dextrose D50% (25 ml) IV* • **Call** House Officer to report BG and action taken	
< 45 mg/dL	• Administer 25 g Dextrose D50% (50 ml) IV* • **Call** House Officer to report BG and action taken	
ALL	• Consider adding Dextrose 5% to maintenance IV fluids at a rate ≥ 50 ml/hr *OR* increasing rate of existing maintenance IV if dextrose source already present	

*If IV access is not available, administer 1 mg glucagon IM and contact provider to obtain IV access. Repeat BG in 30 min.

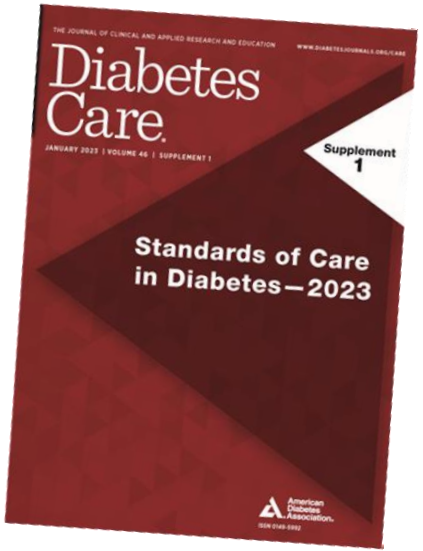
Treatment:

- If patient unresponsive or NPO then IV dextrose given
- If prolonged hypoglycemia, consider dextrose infusion

Steroid induced hyperglycemia in the hospital

16. Diabetes Care in the Hospital:
Standards of Care in Diabetes—2023

Diabetes Care 2023;46(Suppl. 1):S267–S278 | https://doi.org/10.2337/dc23-S016



Steroids

Patient presents with Steroid Induced Hyperglycemia after starting chemo.

Cc: N/V, Pain, Weight loss. On IV steroids and chemo, pt is NPO, with no previous Hx of DM

BS 250-300 mg/dL

What would you do?

A. A1C, start SQ correction insulin
B. A1C, start IV insulin drip
C. A1C c/s DM team
D. A1C start basal and correction insulin

Inpatient Glucose Management – Steroids

Case 2

Insulin Regimen for Steroids

- The insulin regimen should reflect the duration of the steroid
- Example: a ***shorter acting*** steroid like prednisone can be covered with ***increased prandial insulin*** *or* ***an injection of NPH*** insulin at the same time as the prednisone is administered
- Example: ***a longer acting*** steroid like dexamethasone will require ***increases in basal insulin*** *or* ***an IV insulin infusion***
- Dose adjustments for a steroid taper
  - Insulin doses should be decreased at the same percentage that the steroids are being decreased
- Patients with pre-existing diabetes require insulin dose increases from their home doses, including prandial and correctional insulin up to 40 – 60% more.
- Whatever insulin orders are started, adjustments to insulin dosing will need to be made based on anticipated changes in glucocorticoid dosing and POC glucose test results.

Standards of Medical Care in Diabetes 2023

Patient presents with Steroid Induced Hyperglycemia after starting chemo.

Cc: N/V, Pain, Weight loss. On IV steroids and chemo, pt is NPO, with no previous Hx of DM

BS 250-300 mg/dL

WWYD:

A. A1C, start SQ correction insulin
B. A1C, start IV insulin drip
C. A1C c/s DM team
D. A1C start basal and correction insulin

Answer: B and C
Once on oral steroids and taper could switch SQ insulin basal/ increased prandial

Inpatient Glucose Management – Steroids

Case 2 – the plan:

DKA – Diabetic Ketoacidosis

HHS – Hyperosmolar Hyperglycemic State

16. Diabetes Care in the Hospital:
Standards of Care in Diabetes—2023

Diabetes Care 2023;46(Suppl. 1):S267–S278 | https://doi.org/10.2337/dc23-S016

Summary PATHOPHYSIOLOGY DKA / HHNKS

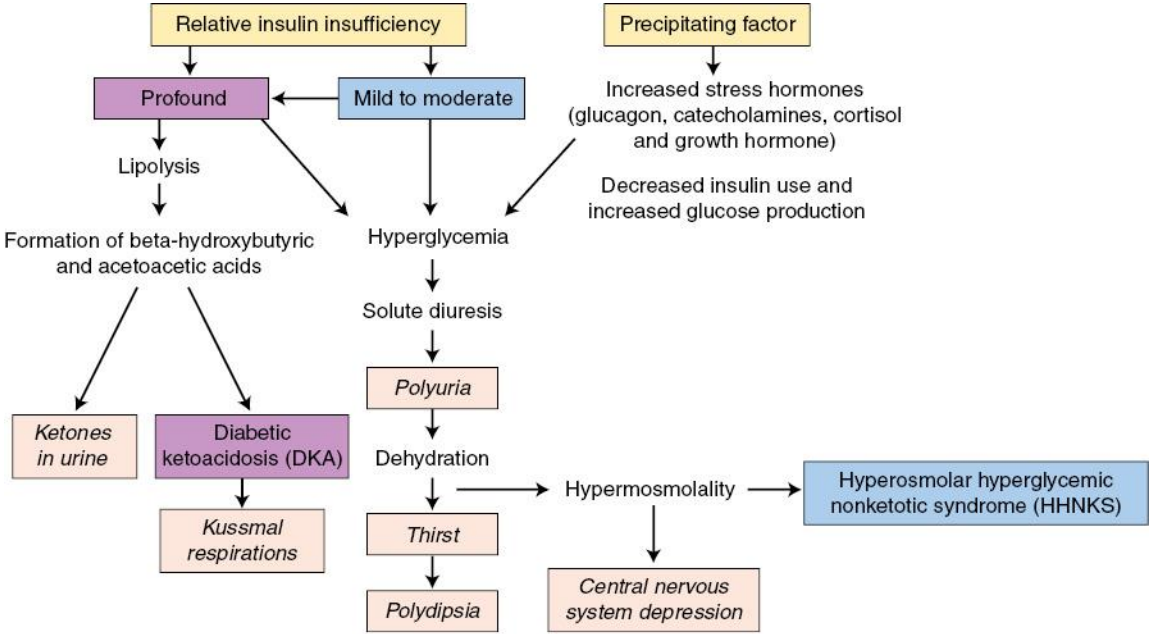


Figure 21-15 Pathophysiology of DKA and HHNKS in diabetes mellitus.

Comparison of DKA & HHS

	DKA	HHS
Glucose	>250	>500
*Osmolarity	Variable	>350
Urinary/ serum ketones (BHB beta-hydroxybutyrate)	++	+ or negative
pH	< 7.3	>7.3
Bicarbonate	<18	>18
**Anion Gap	>12-15	<15
Precipitating illness	Yes	Yes
Mortality	+	++
Age	Young	Elderly

*= osmolality= 2[measured Na(mEq/L)] +glucose/18 + BUN/2.8

**Anion gap = $(Na^+) - (Cl^- + HCO3^-)$

Diabetic Ketoacidosis (DKA)

Profound Insulin deficiency causes rapid mobilization of energy from stores in muscle and fat. These convert to **ketones**.

- **Increased glucose** causes osmotic diuresis which causes the loss of intravascular volume.-**Dehydration**
- Renal blood flow is then decreased and thus the kidney's ability to get rid of glucose is decreased
- Metabolic **acidosis** is caused
- The cycle keeps repeating until interrupted
- Prolonged acidosis can compromise CO and vascular tone and lead to CV collapse

Key features, hyperglycemia, Ketosis, acidosis, dehydration

Present 3Ps weak NV, fatigue, abd pain, fruity acetone breath, kussmaul respirations, tachycardia

Precipitating Infection, illness, not taking insulin, acute event MI CVA, Stress, Surgery, Trauma, T1D evaluate if psychosocial challenges

Plan of Care Treatment key components:

- Monitoring
- Fluid resuscitation
- Insulin and dextrose infusion (insulin drip continues till DKA resolves even if BS normal)
- Electrolyte repletion K+Potassium should be replace **prior** to insulin infusion in patients who present with hypokalemia (<3.5 meq/L)
- Treating underlying cause

LIFE THREATENING

Hyperosmolar Hyperglycemic State (HHS)

- Can sometimes occur when patients get diagnosed w/ Type 2 DM or could be if a Type 2 patient gets ill
- Occurs usually in middle-aged or elderly
- Underlying RI or CHF are common and worsen prognosis
- Precipitating event often identifiable
- Partial insulin deficiency may initiate this and then there is decreased glucose utilization by muscle, fat, and liver. Meanwhile increased liver production of glucose
- Presence of small amount insulin prevents acidosis
- **Marked dehydration** occurs

Key features, hyperglycemia, usually no ketosis

Present Adherence to insulin, Infection, MI, CVA, Trauma

- **Plan of Care Treatment key components:**
- Very similar to management of DKA
  - Fluid resuscitation is the main priority
  - Insulin drip
  - Potassium Electrolyte management
  - Follow up and Education

LIFE THREATENING

SGLT2 Inhibitors and Euglycemic DKA

- The safety and efficacy of SGLT2 inhibitors **have not** been established in patients with T1D Not FDA approved T1D
- Have been cases of acidosis diabetic ketoacidosis (DKA), in patients treated with SGLT2 inhibitors
- Requires emergency room visits or hospitalization to treat the ketoacidosis.
- Usually mildly elevated glucose at less than 200 mg/d – Euglycemic

Triggers: acute illness, UTI, reduced intake, fasting, NPO, reduced insulin dose

Risk: Lower carb intake, lower insulin, greater lipolysis, ketosis

Buschur, E. O., Buse, J. B., Cohan, P., Diner, J. C., & Hirsch, I. B. (2015). Euglycemic diabetic ketoacidosis: a potential complication of treatment with sodium–glucose cotransporter 2 inhibition. *Diabetes care*, *38*(9), 1687-1693.
Plewa, M. C., Bryant, M., & King-Thiele, R. (2020). Euglycemic diabetic ketoacidosis. StatPearls Publishing; Peters, A. L.,

Euglycemic DKA

Diagnosis
• Blood glucose < 250 mg/dL with: pH < 7.3, serum bicarbonate < 18 mEq/L, and anion gap > 12 • Consider checking B-hydroxybutyrate, pH, bicarbonate, and anion gap in patients with diabetes presenting with nausea/vomiting, malaise, or shortness of breath who meet one or more of the risk factors below.
Risk Factors
• Sodium-glucose transport 2 (SGLTs) inhibitors (empagliflozin, canagliflozin, dapagliflozin, Ertugliflozin) • Pregnancy • Alcoholic ketoacidosis will have a very similar presentation • Decreased caloric intake, glycogen storage disease, stress, chronic liver disease, pancreatitis, alcohol use, and cocaine intoxication
Management
• Initiate insulin infusion and start titration of intravenous fluids utilizing two-bag system as described above but using the titration algorithm below to address the higher risk of hypoglycemia. Refer to the IV Insulin Infusion Titration Protocols - Table 3 per the Department of Pharmacy • Minimum insulin infusion rate (e.g., 0.3 units/hr) should be maintained, increasing dextrose rather than holding insulin infusion • Maintain on insulin infusion at minimum rate until resolution of DKA: pH > 7.3, bicarbonate > 18 mEq/L, anion gap < 15 mEq/L   ○ *Resolution of DKA due to SGLT2s may take days due to the duration of action of these medications* • Consider endocrinology consult

Medical Nutrition Therapy in the hospital
Enteral – Tube Feedings
Parenteral - TPN

16. Diabetes Care in the Hospital:
Standards of Care in Diabetes—2023

Diabetes Care 2023;46(Suppl. 1):S267–S278 | https://doi.org/10.2337/dc23-S016

Insulin Regimen for Enteral – Tube Feedings

- Regimen should include coverage of basal, prandial, and correctional needs
- Patients with T1D should receive basal insulin even if feedings are discontinued
- Enteral bolus feedings: Give regular or fast acting subcutaneously before each feeding
- Nocturnal tube feeding: NPH insulin administered with the initiation of feeding

Standards of Medical Care in Diabetes 2023

Insulin Regimen for Parenteral - TPN

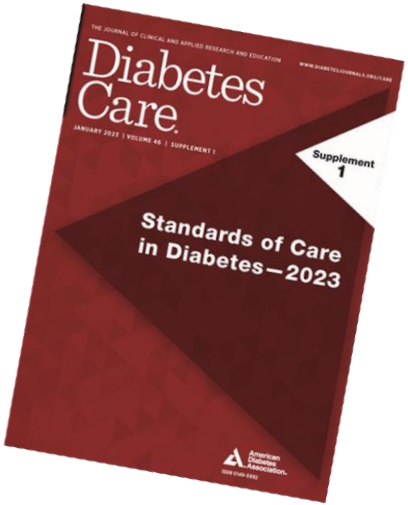
- For patients receiving parenteral nutrition, regular insulin may be added to the solution, especially if >20 units of correctional insulin required in the past 24 hours.
- Recommended to start with 1 unit of regular insulin for every 10 grams of dextrose
- Adding insulin to the TPN bag is safest way to prevent hypoglycemia if TPN is stopped.
- Continue correctional insulin subcutaneously if needed for hyperglycemia

Standards of Medical Care in Diabetes 2023

NPO
Perioperative Care

16. Diabetes Care in the Hospital:
Standards of Care in Diabetes—2023

Diabetes Care 2023;46(Suppl. 1):S267–S278 | https://doi.org/10.2337/dc23-S016



A1C target less 8% for elective surgeries
Peri-op target 100 – 180 mg/dL

NPO/Pre-op/Pre-procedure/ Peri-op Glycemic Management

Standards of Medical Care in Diabetes 2023

ORALS

Hold the day of

SGLT-2 hold 3-4 days prior Resume once patient is eating

*Resume meds containing **metformin** 2 days after IV contrast dye*

*Adjust **insulin doses** based on type of DM and clinical judgement*

NPH or mixed insulin

Reduce 50% the morning of

Reduce 20% evening prior

***Long acting** reduce 20%*

***Insulin pump** reduce 20% basal rates*

*May need additional **short-acting insulin** consider correction factor*

Check BG frequently during first 24 hours post-procedure

If BG control suboptimal, close follow-up with PCP recommended

Standards of Medical Care in Diabetes 2023

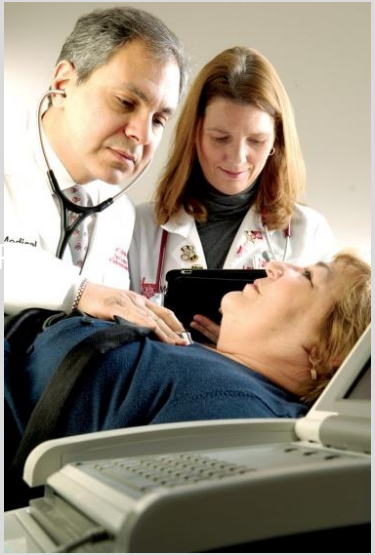
Procedure area Hyperglycemia:

What would you do?

Pt presents to procedure / peri-op area this morning with hi BS above 300 mg/dL

- Bolus with SQ insulin using peri-procedure guideline or correction factor
- Consider labs, A1C
- Consider inpt admit prn and SQ insulin or insulin drip
- Consider fluid bolus if dehydrated
- Consider canceling if chronically elevated BG and elective procedure, refer provider to get better BG control

A1C target less 8% - elective surgery
BG target 100 – 180 mg/dL within 4 hour of surgery



Case 3

Standards of Medical Care in Diabetes 2023

Diabetes Technology in the hospital

7. Diabetes Technology: *Standards of Care in Diabetes—2023*

Diabetes Care 2023;46(Suppl. 1):S111–S127 | https://doi.org/10.2337/dc23-S007

Compare and contrast between Types of DM technology – Terms:

CGM – continuous glucose monitoring

CSII – continuous subcutaneous insulin infusion = insulin pump

AID – automated insulin delivery =

HCL – hybrid closed loop =

= Artificial pancreas

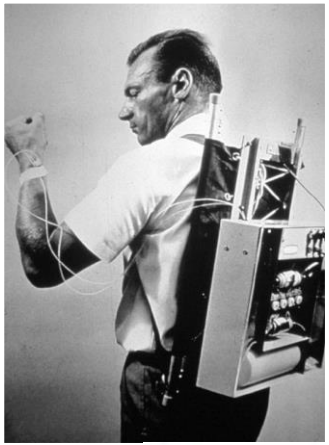
Goal: AID, HCL, artificial pancreas all same use smart algorithms to auto adjust insulin delivery in pump

Goal more time in range (TIR)

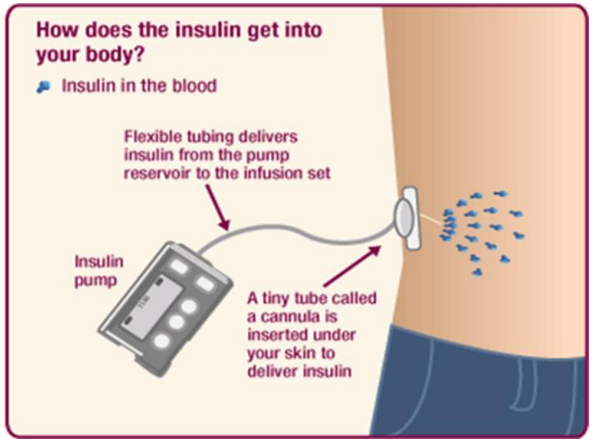
Goal Less hyperglycemia and hypoglycemia excursions

Continuous Subcutaneous Insulin Infusion (CSII) Technology

Insulin Pumps Then….

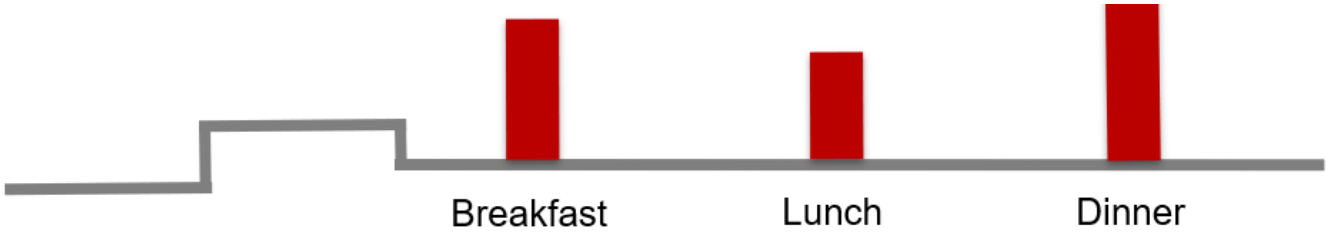


Insulin Pumps Now…



Insulin Pumps

- Can be used alone or with a continuous glucose monitor
- A small mechanical device that continuously delivers insulin though a catheter that placed under the skin
  - Wear for 2-3 days
  - Delivers fast acting insulin two ways
    - Bolus (meal coverage and/or correction)
    - Basal (continuous background coverage- to act as long-acting insulin)



AID Insulin Pump Comparisons

	OmniPod [5]	Medtronic 770G "780G recently approved"	Tandem Control IQ
Integrated CGM	Dexcom G6	Guardian 3	Dexcom G6
Baseline Basal Patterns	Based on insulin delivery hx	Insulin delivery updates q6d	Programmed settings
Algorithm adjust	Based on CGM – 60 min predictive	120 mg/dL	Based on CGM – 30 min predictive
Algorithm and Bolus targets	110 – 150 mg/dL	120 – 150 mg/dL	110 – 160 mg/dL
Temp Override	Activity 150 mg/dL	Temp Target 150 mg/dL	Exercise 140 – 160 mg/dL Sleep 112.5 – 120 mg/dL
Insulin Action	2 – 6 hours	2 - 8 hours	5 hours

5-2023 FDA Approves iLet Beta Bionic Pump

Insulin Pumps – in hospital order set recommended:

DO NOT TAKE OFF or STOP...

Unless patient not alert to self manage

Need specialist to help manage to many devices for staff to know.

Need clear orders
Insulin settings.

Need clear Documentation
of sites and amount insulin Getting, BG

Options to help with management (AID guidance still emerging):

Temporary basal rates

Suspend before low mode (Medtronic)

For automated insulin delivery:

- Temporary target (Medtronic)
- Tandem: Exercise activity
- OP5: Activity

Should have supplies at bedside

Change infusion Site every 3 dys

Caution hyperglycemia assess for kinks or any malfunctions ex: battery charger concerns.

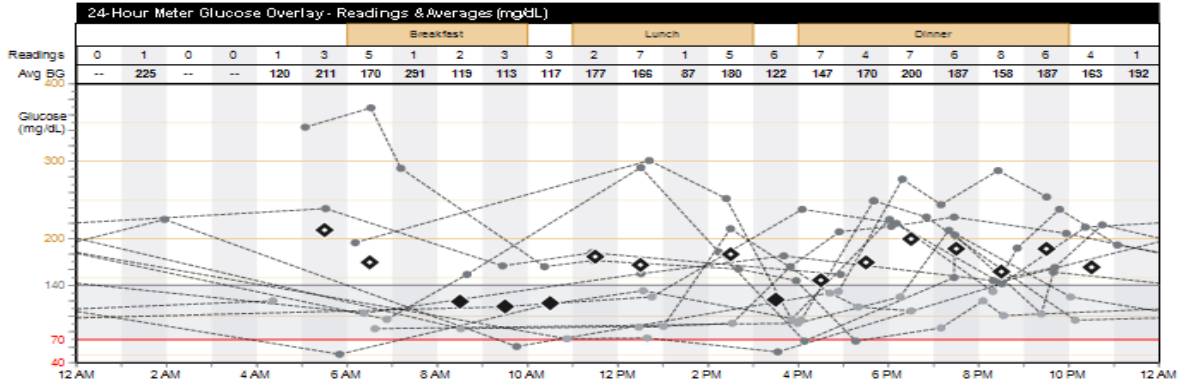
Disconnect for MRI, CT, if surgery more than 3 hours

Plan for alternate form of insulin if needed

Insulin Pump: Medtronic Reports

Sensor & Meter Overview (1 of 2)
3/1/2013 - 3/13/2013

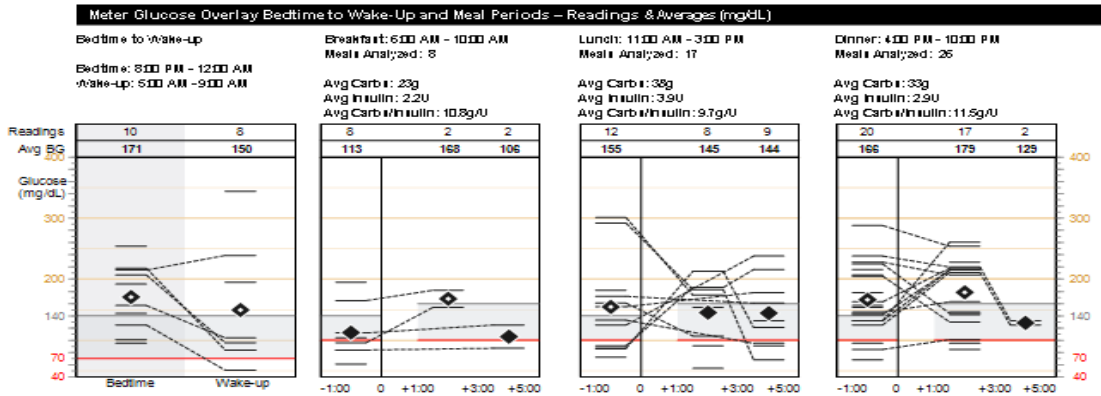
Generated: 4/17/2013 1:25:10 PM
Data Sources: Paradigm Revel - 523 (443031)



Statistics	3/1 - 3/13	
Avg BG (mg/dL)	165 ± 71	
BG Readings	83	6.8/day
Readings Above Target	49	59 %
Readings Below Target	5	6 %
Sensor Avg (mg/dL)	--	
Avg AUC > 140 (mg/dL)	--	--
Avg AUC < 70 (mg/dL)	--	--

Avg Daily Carbs (g)	184 ± 48	
Carbs/Bolus Insulin (g/U)	9.8	

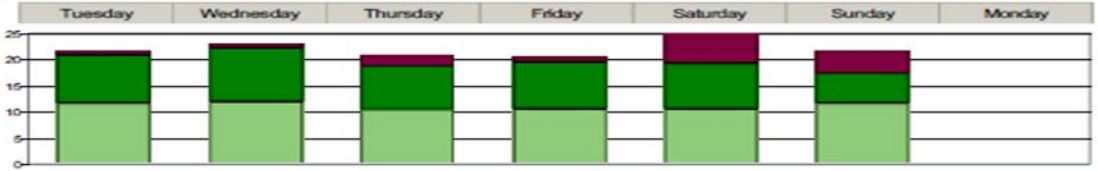
Avg Total Daily Insulin (U)	35.1 ± 4.9	
Avg Daily Basal (U)	16.3	47 %
Avg Daily Bolus (U)	18.8	53 %



Insulin Pump Omni-Pod Reports

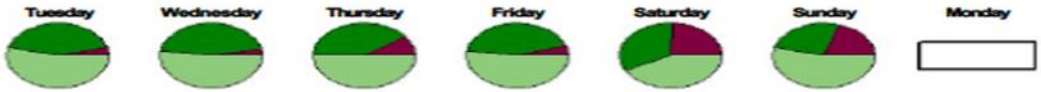
Weekly Pump View

Total Insulin (Units)



	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Monday	Total/Summary
Correction	0.90	0.80	2.00	1.00	5.95	4.45		15.10
Meal Bolus	9.25	10.40	8.30	8.95	8.70	5.80		51.40
Total Bolus	10.15	11.20	10.30	9.95	14.65	10.25		66.50
Basal	11.75	12.00	10.60	10.70	10.65	11.70		67.40
Total Insulin	21.90	23.20	20.90	20.65	25.30	21.95		133.90
Avg/Day Carbs (g)	187	181	148	148	134	98		149

Insulin in %



Daily Insulin in	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Monday	Total/Summary
Corr Bol%	4%	3%	10%	5%	24%	20%		11%
Meal Bolus%	42%	45%	40%	43%	34%	26%		38%
Basal%	54%	52%	50%	52%	42%	54%		51%

Glucose Statistics (mg/dL)	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Monday	Total/Summary
Highest	146	140	178	171	275	219		275
Lowest	57	70	116	81	85	104		57
Average	86	103	140	134	154	160		128
Std Dev	30.0	28.7	26.0	38.6	69.9	43.7		52.1
# Readings	6	3	4	3	5	4		25

Glucose Target Ranges Low Within High

Insulin Meal Correction Basal

Hybrid Closed Loop Insulin Pumps
AID Automated Insulin Delivery

- Omnipod 5
- Tandem Control IQ
- Medtronic 780G

Continuous Glucose Monitoring (CGM) Technology

CGM should be considered in all children and adolescents with **type 1 diabetes**, whether using injections or continuous subcutaneous insulin infusion, as an additional tool to help improve glucose control.

CGMs in conjunction with insulin therapy are useful tools to lower A1C and/or reduce hypoglycemia in adults with **type 2 diabetes** who are not meeting glycemic targets.

Standards of Medical Care in Diabetes 2023

CGMs

Continuously monitors senor glucose

Provides trend arrows ⬆ ⬇ ➡

If this was your meter reading, what would your next step be?

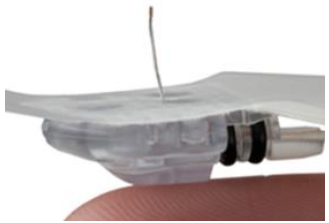
Then…. AC &HS

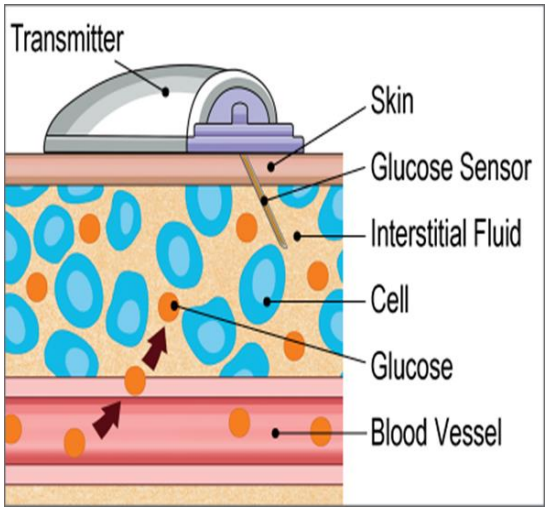
How would you respond if you saw this instead?

Now….real time

Continuous Glucose Monitors

- Sensor placed under skin held in place with adhesive
- Continuously measures glucose levels in the interstitial fluid
- Transmitter connected to sensor sends data to receiver or compatible smart device displays reading every 1-5 min
- Can be used alone or with an insulin pump
- Provides downloads, reports to analyze patterns
- Optional Alert Features:
  - High or low sensor glucose alarms
  - Rising or dropping sensor glucose
  - Temporarily suspends insulin (Medtronic & T-slim)





CGMs on the Market Now

- Freestyle Libre 14 day, 2, 3
- Dexcom G6, G7
- Eversense
- Medtronic Guardian

✋ *Using ????*
@ Work or home???

THE OHIO STATE UNIVERSITY
WEXNER MEDICAL CENTER

Example Guideline

Policy Name: Continuous Subcutaneous Insulin Infusion (CSII) Pumps and Continuous Glucose Monitoring (CGM)

Definitions

Term	Definition
CGM	Continuous Glucose Monitor
CSII	Continuous Subcutaneous Insulin Infusion Pump

CGM not FDA approved in hospital
COVID – MICU – emergency use

	Acetaminophen interference	Calibrations required	Confirmatory fingersticks required prior to treatment (outpatient use)*	Remove for CT	Remove for MRI or diathermy or local electricautery	Remove for x-ray
Dexcom G6®	N	N	N	N	Y	N
Medtronic©	Y	Y	Y	N	Y	N
Freestyle Libre™	N	N	N	N	Y	N
Freestyle Libre 2™	N	N	N	N	Y	N
Eversense® (surgical implant)	Not specified	Y	Y	Y (remove transmitter)	Y (remove sensor + transmitter)	Y (remove transmitter)

- CGM can have some variability esp. if glucose rapidly changing, lag.
- Interference: uric acid, galactose, xylose, ascorbic acid…

- For now: keep CGM on, still BG check, studies pending….
- Can view reports possibly help with adjustments for discharge planning.

For reference CGM….

Resource 1. CGM Systems

	FreeStyle Libre 14 day[8]	FreeStyle Libre 2[8]	FreeStyle Libre 3[9]	Dexcom G6[10]	Dexcom G7[11]	Medtronic Guardian Connect[12,14]	Eversense E3 CGM[7]
Age	18 and up	4 years and up	4 years and up	2 years and up	2 years and up	14-75 years old	14 years and up
Wear Time	14 days	14 days	14 days	10 days	10 days	7 days	180 days
Calibration	**No Need**	**No Need**	**No Need**	**No Need**	**No Need**	**2x/day**	**2x/day**
Insertion Site	Back of arm	Back of arm	Back of arm	Abdomen or upper buttocks	Upper arm or abdomen (age 2+) or upper buttocks (age 2-6)	Abdomen or back of the arm	Arm implant
Hyper/Hypoglycemic Alerts	No	Yes	Yes	Yes	Yes	Yes	Yes
Rapid Change in Blood Glucose	Less reliable	Reliable	Most reliable	More reliable, 30 minute prediction	Most reliable, 30 minute prediction	More reliable, 60 minute prediction	Reliable
Data Transmission	Every 1 minute, must scan within 8 hours	Every 1 minute, must scan within 8 hours	Every 1 minute (no scanning)	Every 5 minutes via Bluetooth	Every 5 minutes via Bluetooth	Every 5 minutes via Bluetooth	Every 5 minutes via Bluetooth
Links to App	+	+	+	+	+	+	+

CARDI·OH
Ohio Cardiovascular and Diabetes Health Collaborative

PATTERN MANAGEMENT

CARDI•OH
Ohio Cardiovascular and Diabetes Health Collaborative

1. Review medication taking behaviors.
2. Assess meal times, snacks, particularly overnight.
3. Assess overall glycemic status (TIR, mean glucose).[9]
4. Address hypoglycemia first if Time below Range (TBR) is above target.[9]
5. Address AM/fasting glucose.
6. Assess non-fasting glucose.
7. Evaluate patterns related to physical activity or work.

9. Grunberger G, et al. Endocr Pract. 2021;27(6):505-537.

CGM Results

CARDI•OH
Ohio Cardiovascular and Diabetes Health Collaborative

- Continuous glucose monitoring (CGM) results in
  - Reduction in HbA1C[1,2]
  - Improved percentage of Time in Range (TIR), defined as 70-180 mg/dL[2]
  - Lower risk of hypoglycemia[2]
  - High patient satisfaction[2,3]
  - Lower risk of diabetes-related hospitalizations[4,5]
- Increasingly utilized in primary care practices as coverage and access expands.[6]

1. Yaron M, et al. Diabetes Care. 2019;42(7):1178-1184
2. Martens T, et al. JAMA. 2021;325(22):2262-2272
3. Gilbert TR, et al. Diabetes Technol Ther. 2021;23(S1):S35-S39
4. Bergenstal RM, et al. J Endocr Soc. 2021;5(4):bvab013
5. Roussel R, et al. Diabetes Care. 2021: 44(6):1368-1376
6. Martens TW. Curr Opin Endocrinol Diabetes Obes. 2022;29(1):10-16

CGM Advantages

- Ability to recognize early glucose fluctuations
- Detect unknown glucose excursions
- Alarms for readings out of range
- Answers the question “what is going on with my glucose?”

CGM Disadvantages

- Cost
- Discrepancies from glucose readings
- 2-3 additional equipment pieces
- “Overwhelmed” with data
- Alarm fatigue
- Skin irritation

Standardized CGM Metrics

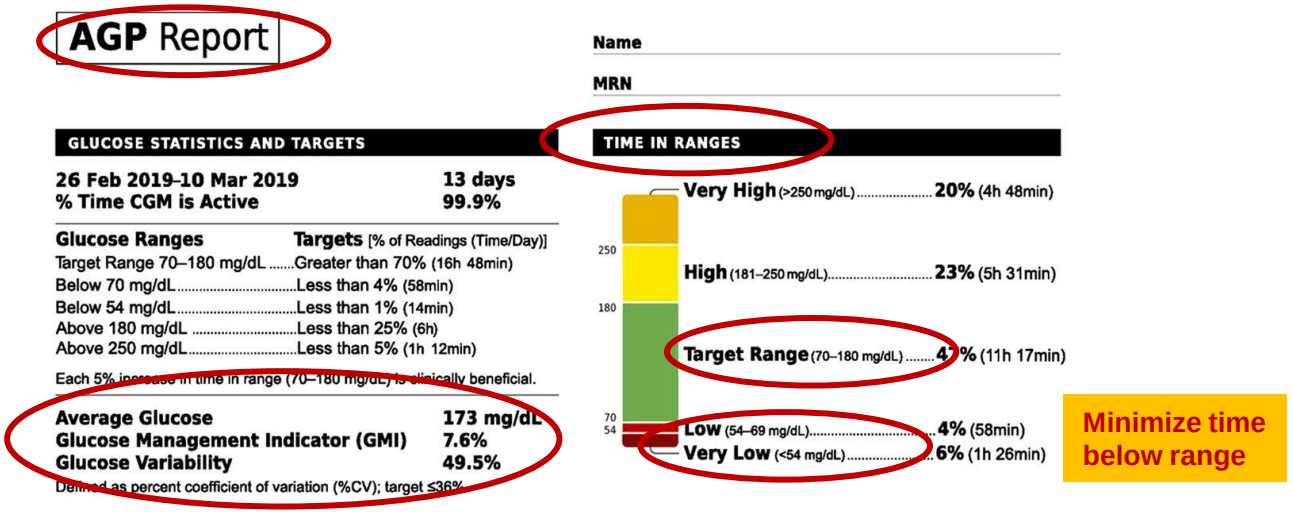
Table 6.2—Standardized CGM metrics for clinical care	
1. Number of days CGM device is worn (recommend 14 days)	
2. Percentage of time CGM device is active (recommend 70% of data from 14 days)	
3. Mean glucose	
4. Glucose management indicator	
5. Glycemic variability (%CV) target ≤36%*	
6. TAR: % of readings and time >250 mg/dL (>13.9 mmol/L)	Level 2 hyperglycemia
7. TAR: % of readings and time 181–250 mg/dL (10.1–13.9 mmol/L)	Level 1 hyperglycemia
8. TIR: % of readings and time 70–180 mg/dL (3.9–10.0 mmol/L)	In range
9. TBR: % of readings and time 54–69 mg/dL (3.0–3.8 mmol/L)	Level 1 hypoglycemia
10. TBR: % of readings and time <54 mg/dL (<3.0 mmol/L)	Level 2 hypoglycemia

CGM, continuous glucose monitoring; CV, coefficient of variation; TAR, time above range; TBR, time below range; TIR, time in range. *Some studies suggest that lower %CV targets (<33%) provide additional protection against hypoglycemia for those receiving insulin or sulfonylureas. Adapted from Battelino et al. (35).

Glycemic Targets:
Standards of Care in Diabetes - 2023. *Diabetes Care* 2023;46(Suppl. 1):S97-S110

Standardized Report Interpret BG data
Ex: EKG can use different machine but reading same
How download reports variable - need to standardize

GLYCEMIC TARGETS

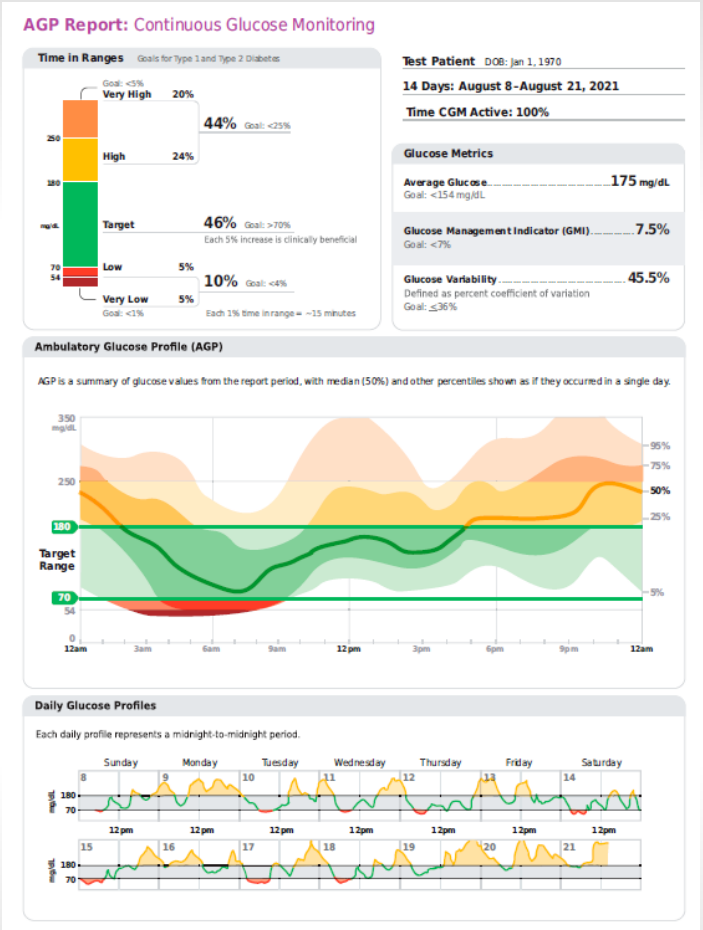


Minimize time below range

AGP ambulatory glucose profile
TIR Time in Range 70-180 mg/dL
GMI Glucose Management Indicator (estimate A1C from CGM)

Glycemic Targets:
Standards of Medical Care in Diabetes - 2023.

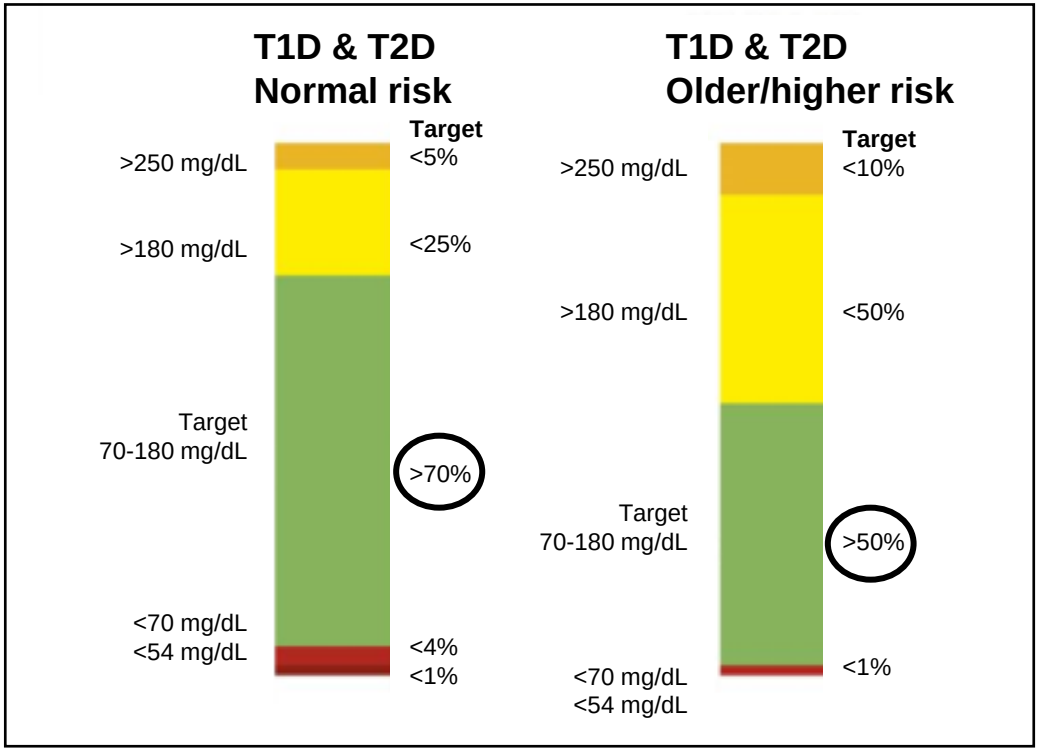
GLYCEMIC TARGETS



Glycemic Targets:
Standards of Care in Diabetes - 2023. *Diabetes Care* 2023;46(Suppl. 1):S97-S110

American Diabetes Association.
Connected for Life

CGM Goals
International Consensus on TIR



T1D: Type 1 Diabetes; T2D: Type 2 Diabetes

- The goal TIR for most individuals is 70% with 4% TBR and 1% of time below 54 mg/dl
- The goal TIR for older or higher risk individuals is 50% with <1% TBR

Use to guide insulin dose adjustments
Reevaluate treatment plan:

8. Battelino T, et al. Diabetes Care. 2019;42(8):1593–1603

Ambulatory Glucose Profile

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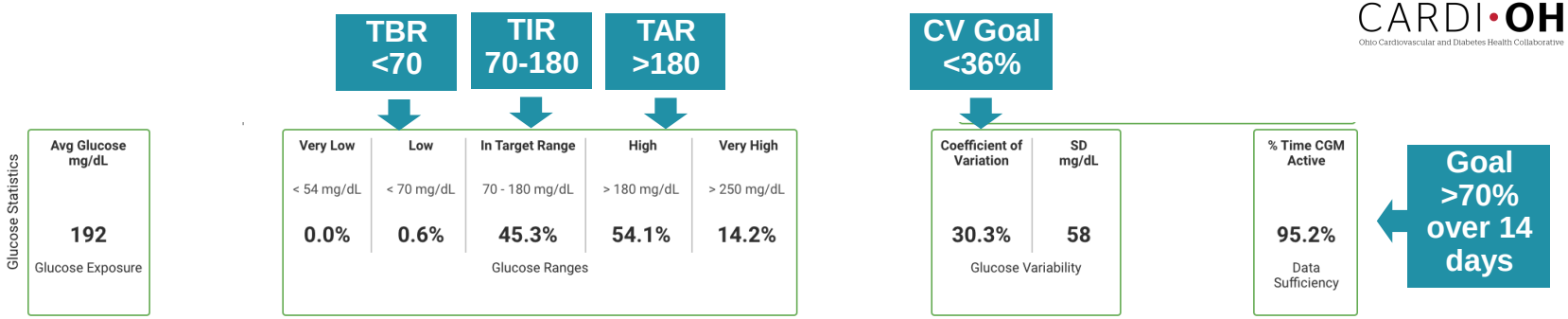
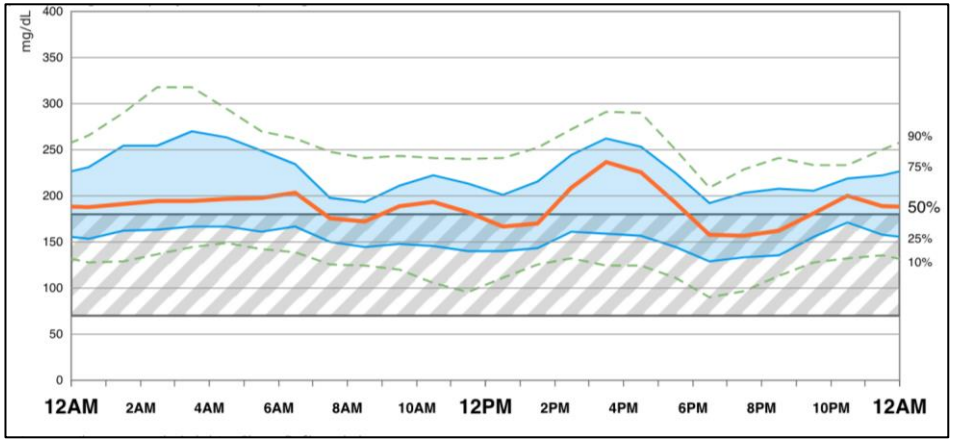


Check that target set to 70-180 mg/dL

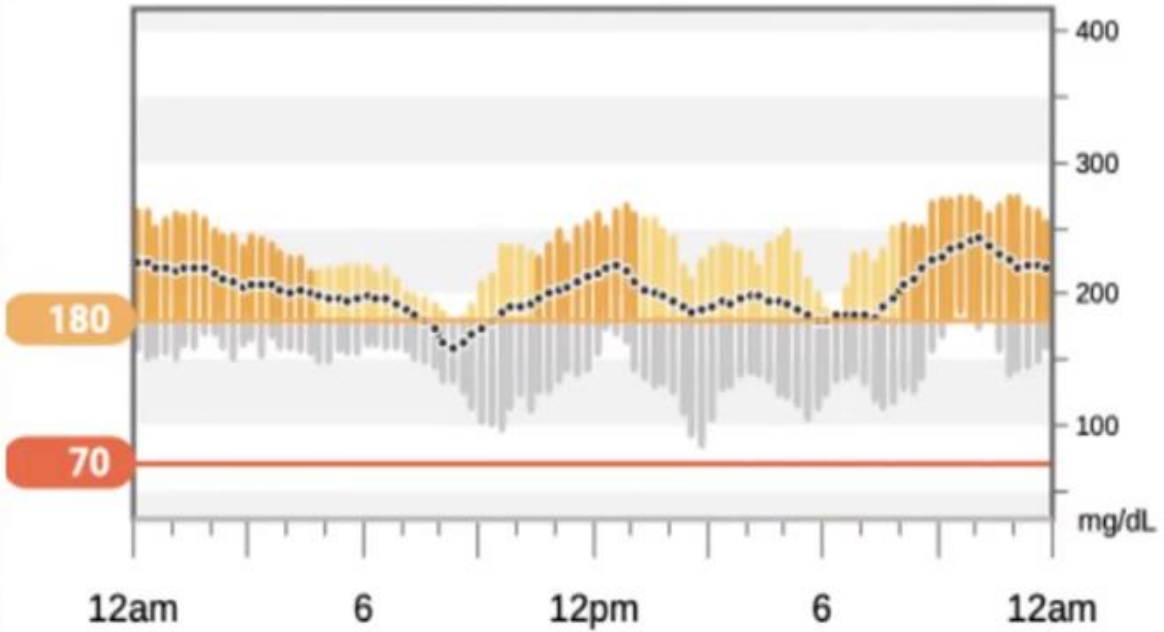


- TIR (Time in Range)
- TAR (Time above Range)
- TBR (Time below Range)

Case: Ms. I

Interpreting CGM Downloads:

CARDI·OH



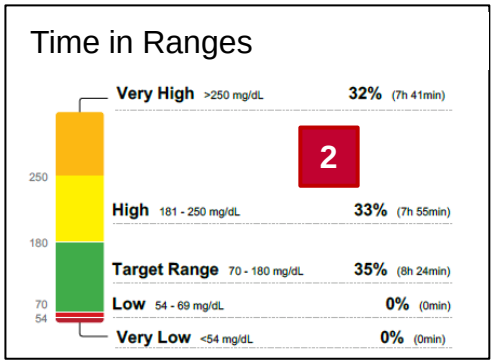
https://www.cardi-oh.org/echo/Fall-2022-Continous-Glucose-Monitoring

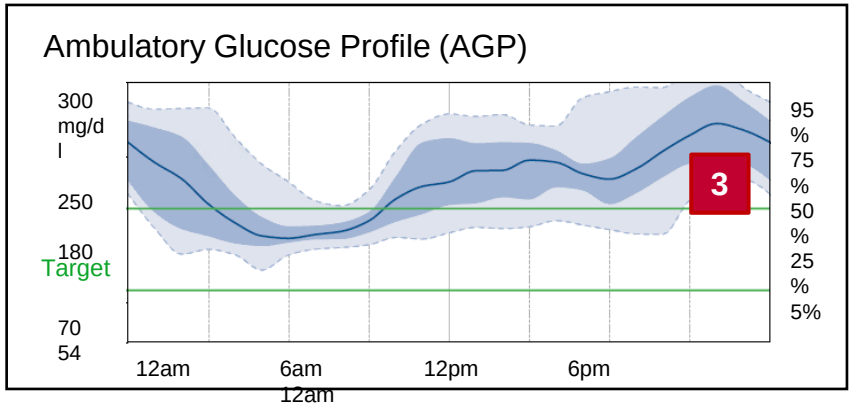
81

Ms. O. CGM Case: Need for Prandial Insulin

- % Time CGM Active: 76%
- Mean Glucose: 219 mg/dL
- GMI: 8.5%
- % CV: 30.5%

1





Patient Summary
- 52-year-old female with T2D, no complications
- Weight: 90 kg

Current Treatment
- Metformin, Glimepiride
- Dulaglutide 1.5 mg weekly
- Glargine 60 units daily

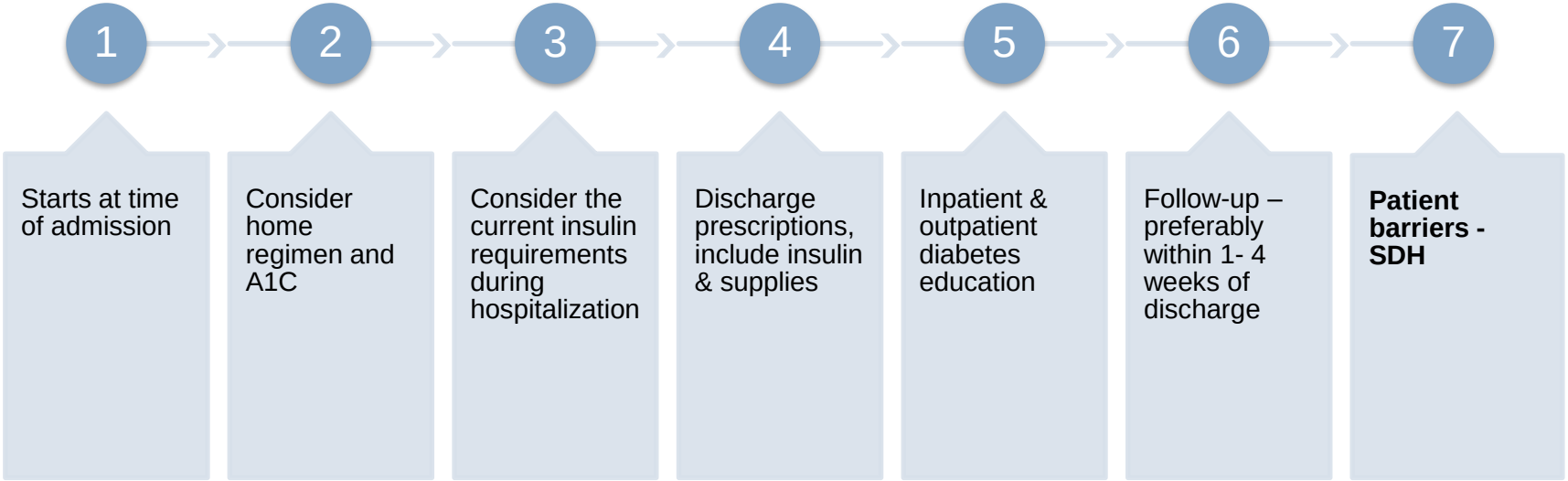
CGM Interpretation (*red boxes ☐*)
- (1) Adequate amount of data
- (2) TIR is 35% (goal >70%)
- (3) Pattern is predominantly post-prandial hyperglycemia

Plan
- Titrate dulaglutide to 3 to 4.5 mg
- Stop glimepiride
- Start prandial insulin at largest meal of the day
- *Do not increase basal insulin because the dose is already >0.5 unit/kg and there is a high bedtime to morning differential.*[10]

10. American Diabetes Association Professional Practice Committee. Diabetes Care. 2022;45(Supplement_1):S125–S143

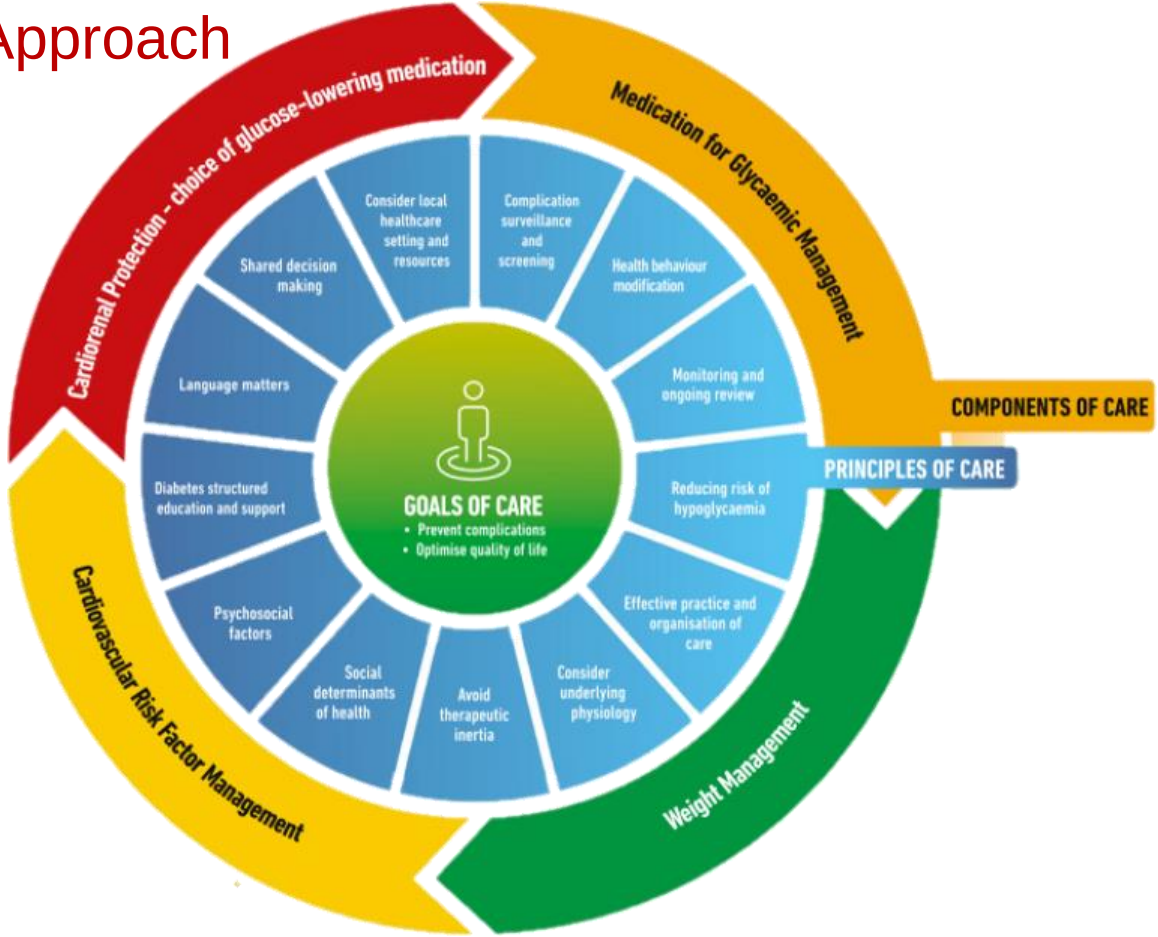
Discharge Planning

Discharge Planning



Holistic Person-Centered Approach

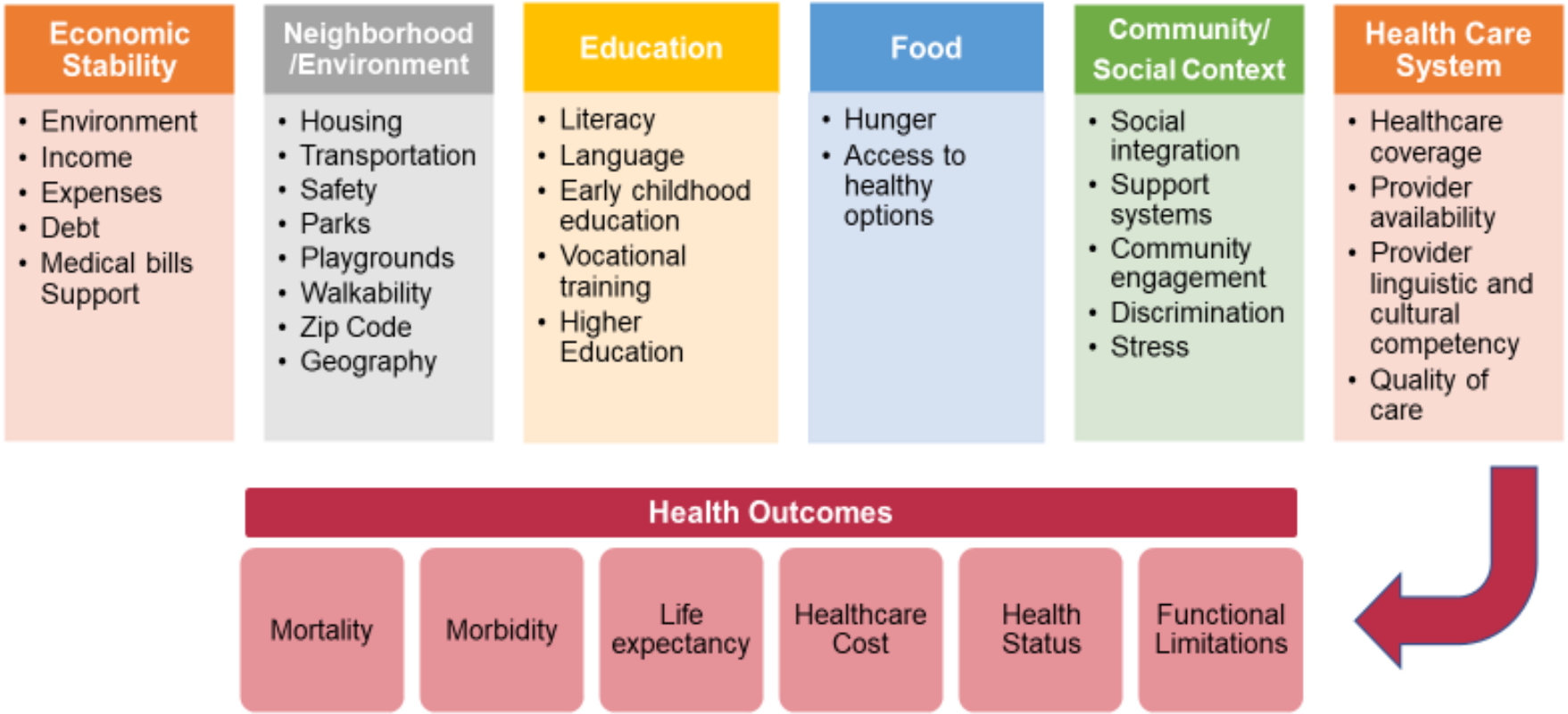
- The goals of person-centered care are to prevent complications and optimize quality of life.
  - Complications
  - Health Behaviors
  - Monitoring
  - Hypoglycemia
  - Effective practice
  - Underlying physiology
  - Therapeutic inertia
  - Social determinants
  - Psychosocial factors
  - DSMES
  - Language matters
  - Shared decision making
  - Health care setting/resources



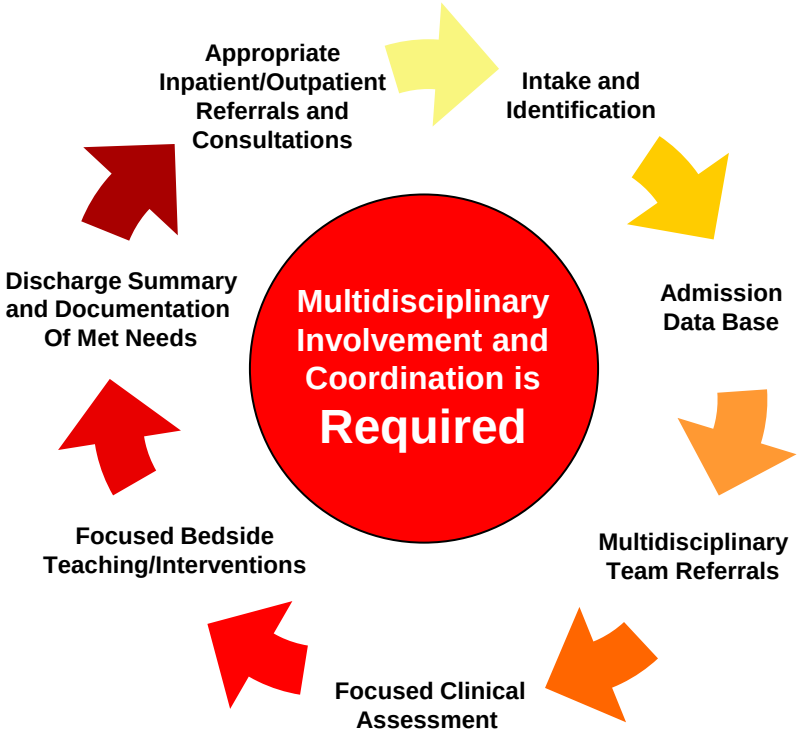
Davies et al. Diabetologia. 2022;65(12):1925-1966. doi: 10.1007/s00125-022-05787-2

Be aware of resources in your area to address health disparities:

Social Determinants of Health



Connecting Inpatient to Outpatient Support: Multidisciplinary Circle of Care

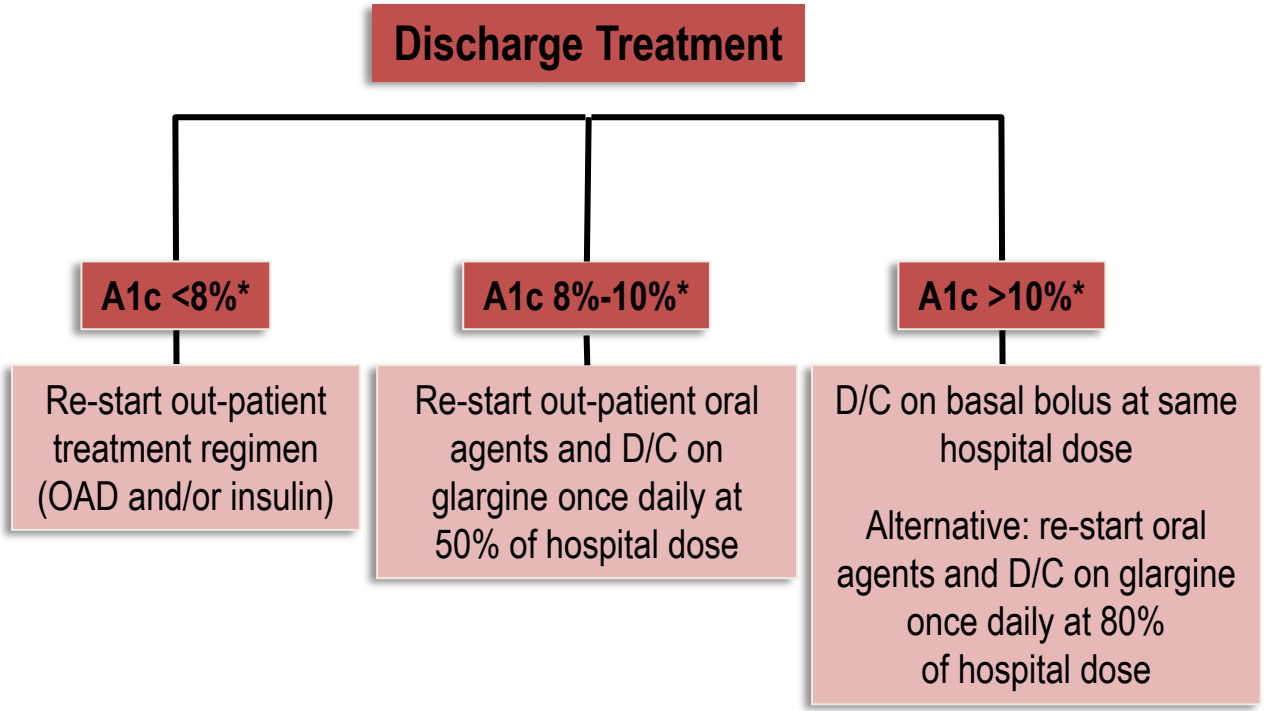


Ex: OSU East
DM Transition of Care Clinic

Ex: DM discharge order sets
Ex: Bedside Med Delivery

AACE Inpatient Glycemic Control Resource Center
Improving Inpatient Diabetes Care Nursing Issues 2010

Revised Discharge Algorithm



***Use admission A1c to adjust therapy at discharge**

Umpierrez et al. *Diabetes Care*. 2014;37:2934-2939.

Cautions and Contraindications to Oral Medications

Diabetes Medication Class	Drug Examples (not all encompassing*)	Cautions (not all encompassing*)	Contraindications (not all encompassing*)
Biguanides	Metformin	CHF, alcohol abuse	eGFR < 46, lactic acidosis, hepatic disease
DPP4-Inhibitors	Sitagliptin (Januvia) Linagliptin (Tradjenta)	CrCl < 45	History of pancreatitis
GLP-1 Agonists	Exenatide (Bydureon) Dulaglutide (Trulicity) Liraglutide (Victoza) Semaglutide (Ozempic)	Pancreatitis history, GI disease, gastroparesis, renal impairment	Medullary thyroid carcinoma history or family history
SGLT2 Inhibitors	Empagliflozin (Jardiance) Dapagliflozin (Farxiga) Canagliflozin (Invokana)	eGFR 45-59, hypotension, CHF, ketoacidosis risk, elderly, UTI or yeast infection history	DKA, eGFR < 45
Sulfonylureas	Glimepiride	Renal impairment, hepatic	CrCl <50

What's supported in guidelines and can continue to be developed for inpatient glycemic control :

- Use of technology insulin pumps and continuous glucose monitors
- DM self management, self administer insulin and glucose monitoring
- Insulin dosing calculator to stream-line Lispro dosing process for nurses
- DM teams of specialists and educators
- Uncomplicated DKA treated with SQ insulin and fluids in ED and on monitored units with protocols in place
- Medication reconciliation with prior to arrival and hospital meds
- Receiving prescriptions prior to discharge

Standards of Medical Care in Diabetes 2023

Before Closing ….
Resources

Diabetes Med & Insulin PocketCards
https://diabetesed.net/pocket-cards-insulin-and-diabetes-medication/
Diabetes Education Services (DES)

Table 1. 2022 Ohio Medicaid Preferred Diabetes Formulary *As of July 2022*

Drug Class	Preferred
Non-Insulin	

Metformin and combination	• Metformin in combination with
	  ○ Pioglitazone
	  ○ Glyburide
	  ○ Canagliflozin, empagliflozin
	  ○ Sitagliptin, linagliptin
	  ○ Repaglinide
	• Metformin ER (Glucophage XR)

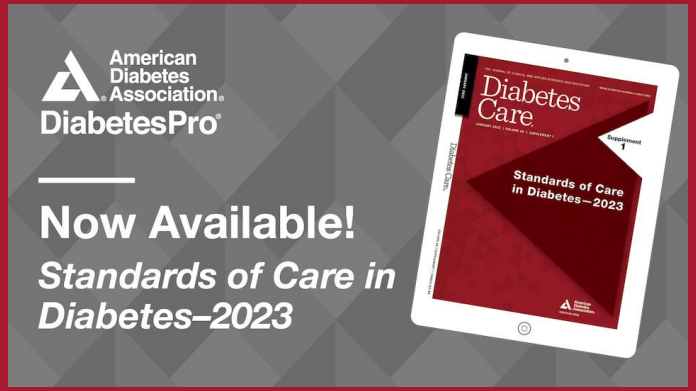
Sulphonylurea SFU	glimepiride, glipizide, glyburide
Glucagon-like peptide-1 receptor agonist GLP-1 RA	Byetta (exenatide), Trulicity (dulaglutide), Victoza (liraglutide)
Sodium-glucose cotransporter-2 inhibitor SGLT2i	Farxiga (dapagliflozin), Invokana (canagliflozin), Jardiance (empagliflozin)
Dipeptidyl peptidase-4 inhibitor DPP-4i	Januvia (sitagliptin), Tradjenta (linagliptin)
Thiazolidinedione TZD	pioglitazone
Alpha glucosidase inhibitor AGI	acarbose, miglitol
Glinide	nateglinide, repaglinide

- No step therapy is required for most medications on formulary
- Continuous glucose monitors are now covered without the need for prior authorization

Insulin	
Basal	Lantus (glargine), Levemir (detemir), Toujeo (glargine U-300), Tresiba (degludec)[5]
Bolus	Apidra (glulisine), aspart, Humalog (lispro) U-100, Humulin R (regular insulin) U-500, lispro, Novolog (aspart) U100
Premix	Humalog 50/50 (lispro protamine/lispro), Humalog 75/25 (lispro protamine/lispro), Humulin 70/30 (insulin isophane/regular insulin), aspart protamine/aspart, Novolog 70/30 (aspart protamine/aspart)

[5] Step therapy

Consumers guide to products:
https://consumerguide.diabetes.org/

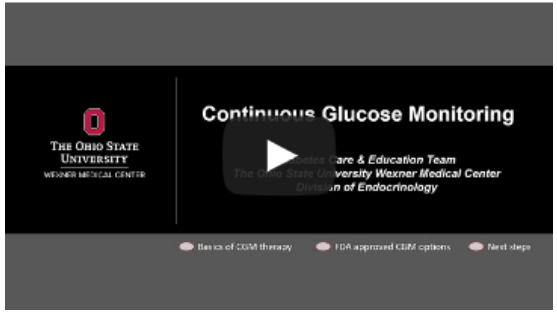


- Full version available
- Abridged version for PCPs
- Free app, with interactive tools
- Pocket card with key figures
- Free webcast for continuing education credit

Professional.Diabetes.org/SOC

American Diabetes Association.
Connected for Life

Diabetes Technology Video and OSUWMC Diabetes Education Resouces



To learn more about diabetes technology, please view our ***Diabetes Technology Video***. This video will direct you through the OSUWMC process in obtaining a new insulin pump, continuous glucose monitor or smart pen.

HOW TO REALLY MAKE IT WORK

Delivery arrangements

How, where and by who care is delivered

Coordination of care and management of care processes

Information and communication technology

Governance arrangements: Accountability for health professionals

Training and certification

Quality of practice

Implementation strategies

Health system

Health care setting

Health care workers

American Diabetes Association.

Davies MJ, Aroda VR, Collins BS, Gabbay RA, Green J, Maruthur NM, Rosas SE, Del Prato S, Mathieu C, Mingrone G, Rossing P, Tankova T, Tsapas A, Buse JB

Diabetes Care 2022; https://doi.org/10.2337/dci22-0034. *Diabetologia* 2022; https://doi.org/10.1007/s00125-022-05787-2.

EASD European Association for the Study of Diabetes

INSURANCE COVERAGE*

Durable Medical Equipment

Type 1 Diabetes

Insurance	DME Pump (Medtronic, Tandem, Beta Bionic)	Pharmacy Pump (OP5)	CGM
Private	Yes	Usually	Yes DME or Pharmacy
Medicare	Yes	Usually	Yes DME
Medicaid	Yes	Yes	Yes - Pharmacy

Top
Current

Type 2 Diabetes

Insurance	DME Pump (Medtronic, Tandem, Beta Bionic)	Pharmacy Pump (OP5)	CGM
Private	Usually	Usually	Yes DME or Pharmacy
Medicare	Yes with labs	Usually	Yes DME
Medicaid	Yes	Yes	Yes - Pharmacy

Insurance	Pump	CGM
Private	Usually	Usually
Medicare	Yes	Dexcom Only
Medicaid	Yes	No

Bottom
Yrs prior

Insurance	Pump	CGM
Private	Usually	Varies
Medicare	No	No
Medicaid	No	No

DIABETES SELF-MANAGEMENT EDUCATION AND SUPPORT

Embrace DSMES as being as important as other aspects of diabetes care such as pharmacotherapy.

Identify and know how to access your local DSMES resources.

Impress upon the person and the healthcare team the importance of DSMES in the ongoing holistic approach to the management of type 2 diabetes.

Initiate or refer for DSMES at diagnosis, annually, with changes in social or health status and with transitions of care or life situation.

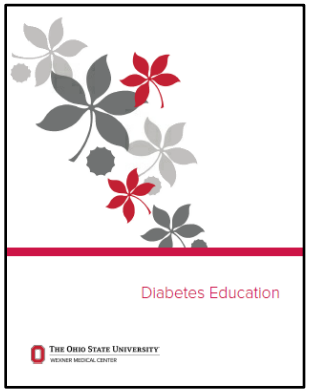
American Diabetes Association.

Davies MJ, Aroda VR, Collins BS, Gabbay RA, Green J, Maruthur NM, Rosas SE, Del Prato S, Mathieu C, Mingrone G, Rossing P, Tankova T, Tsapas A, Buse JB

Diabetes Care 2022; https://doi.org/10.2337/dci22-0034. *Diabetologia* 2022; https://doi.org/10.1007/s00125-022-05787-2.

EASD European Association for the Study of Diabetes

Examples
Lifestyle and DM Education Materials OSUWMC



https://go.osu.edu/pted3577

https://go.osu.edu/pted4524

Person-Centered Language Recommendations

The ADA and the APA recommend language that emphasizes inclusivity and respect:

- **Gender**: Gender is a social construct and social identity; use term “gender” when referring to people as a social group. Sex refers to biological sex assignment; use term “assigned sex” when referring to the biological distinction.
- **Race**: Race is a social construct that is used broadly to categorize people based on physical characteristics, behaviors, and geographic location. Race is not a proxy for biology or genetics. Examining health access, quality, and outcome data by allows the healthcare system to assist in addressing the factors contributing to inequity.
- **Sexual Orientation**: Use the term “sexual orientation” rather than “sexual preference” or “sexual identity.” People choose partners regardless of their sexual orientation; however, sexual orientation is not a choice.
- **Disability**: The nature of a disability should be indicated when it is relevant. Disability language should maintain the integrity of the individual. Language should convey the expressed preference of the person with the disability.
- **Socioeconomic Status**: When reporting SES, provide detailed information about a person’s income, education, and occupation/employment. Avoid using pejorative and generalizing terms, such as “the homeless” or “poor.”
- **Violent Language**: Avoid sayings like ‘killing it,’ ‘pull the trigger,’ ‘take a stab at it,’ ‘off the reservation,’ etc.

Flanagin A et al., 2021, JAMA; Dickinson JK et al., Diabetes Care, 2017; American Psychological Association, 2021; ODM, 2021.

Additional Cardi-OH Resources

- **Beyond the A1C: Targets for Blood Glucose and Methods of Measurement**
  cardi-oh.org/best-practices/diabetes-management/beyond-the-a1c-targets-for-blood-glucose-and-methods-of-measurement

- **Outpatient Diabetes Management for Primary Care Providers: Medications Intensification and Algorithm**
  cardi-oh.org/best-practices/diabetes-management/outpatient-diabetes-management-for-primary-care-providers-medications-intensification-and-algorithm

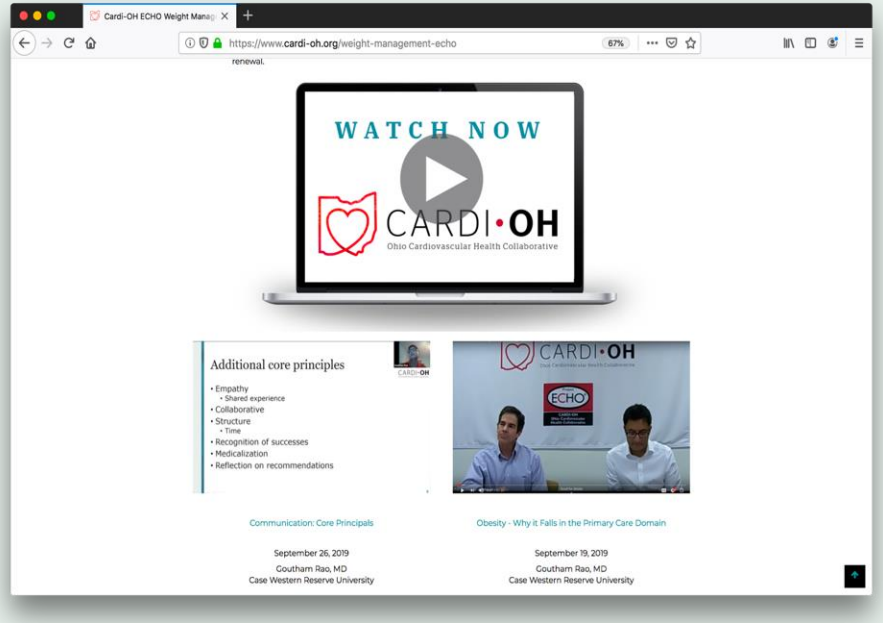
- **Optimizing the Telehealth Diabetes Visit: Glucose Monitoring Data**
  cardi-oh.org/best-practices/diabetes-management/optimizing-the-telehealth-diabetes-visit
  (reimbursement codes, office, logistics, downloads)

Watch Cardi-OH TeleECHO Clinic Recordings

Register on Cardi-OH.org to watch the current clinic:
cardi-oh.org/user/register

Current Clinic page (access recordings):
cardi-oh.org/echo/cardiovascular-prevention-fall-2022

Access previous Cardi-OH TeleECHO Clinics:
cardi-oh.org/echo/archived-clinics



Future Therapies

- Once weekly basal insulin (Icodec)
- Glucose responsive insulin
- Combined peptides: GLP-1/GIP, GLP-1/glucagon receptor dual agonist, GLP-1/glucagon/GIP
- Others
  - Glucagon receptor antagonist
  - G-protein-coupled receptor ligands
  - Hormone/enzyme/receptors
  - PPARs: insulin sensitizers
  - Glimins: correction of mitochondrial dysfunction

Perreault l, Skyler JS, Rosenstock J. Rev Endocrinol. 2021 Jun;17(6):364-377. doi: 10.1038/s41574-021-00489-y.
Shah et al. Ther Adv Endocrinol Metab 2021;12:1-30. DOI: 10.1177/ 20420188211042145.

Future Approaches

- Adult-onset DM sub-types[1]
- Precision medicine:[2]
  - Patient-level markers predict response to therapy, complications
  - Emphasis on clinical utility, equity
- Early combination therapy in some patients at treatment initiation to extend the time to treatment failure.[3,4]
- Connected devices for monitoring and treatment

1. Ahlqvist et al. Lancet Diabetes Endocrinol. 2018;6(5):361-369.
2. Nolan et al. ADA/EASD Precision Medicine in Diabetes Initiative. Diabetes Care. 2022;45(2):261-266.
3. Davies et al. ADA Standards of Care. Dia Care 2022;45(Suppl. 1):S125–S143.
4. Garber et al. AACE Consensus Statement. Endocr Pract 2019;25(1):69-100.

Most Recent Diabetes and Technology Guidelines

Professional Group(s)	Year	Title
AACE	2023	American Association of Clinical Endocrinology Clinical Practice Guideline: Comprehensive Type 2 Diabetes Management Algorithm
ADA	2023	Standards of Medical Care in Diabetes
ADA/EASD	2022	Management of hyperglycemia in Type 2 Diabetes. A consensus report by the American Diabetes Association and the European Association for the Study of Diabetes EASD
AACE	2021	Advanced Diabetes Technology Guideline
ADA/EASD	2021	The Management of Type 1 Diabetes in Adults. A Consensus Report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD)
EASD/ISPAD^	2020	Glucose management for exercise using continuous glucose monitoring (CGM) and intermittently scanned CGM (isCGM) systems in type 1 diabetes
International Consensus*	2019	Clinical Targets for Continuous Glucose Monitoring Data Interpretation: Recommendations From the International Consensus on Time in Range
Endocrine Society	2017, 2018	Endocrine Society Dosing Method Based on CGM Trend Arrows and CF
EASD/ADA	2017	Improving the Clinical Value and Utility of CGM Systems: Issues and Recommendations

Summary Key Take Aways

- Insulin is the preferred method of treating hyperglycemia in the hospital
- Standard protocols promote consistency in inpatient glucose management and facilitate high quality care
- Poor glycemic control in the hospital can lead to poor patient outcomes
- Treat patients with physiologic insulin including basal, bolus and correction factor and know the action of insulin
- Connect patients to outpatient follow up
- Expect continued advances in technology insulin pumps and continuous glucose monitors
- CSII and CGM can improve glucose management and there is consensus for monitoring and use of technology

Thank you...
Thank you very much….

Questions ?

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