DIABETES MANAGEMENT

Itivrita Goyal, MD
Assistant Professor of Medicine
Endocrinology, Diabetes and Metabolism
University of Oklahoma Health Sciences Center

EXPLORE
HEALTHCARE SUMMIT

Disclosures

None to disclose

Objectives

- At the end of this session, learners will be able to:
  - Learn the classification of Diabetes Mellitus
  - Understand the glycemic targets used for management of diabetes mellitus
  - Choose from various insulin and non-insulin drug classes available to treat type1 and type 2 diabetes
  - Make use of technology in management of diabetes
  - Manage diabetes mellitus/hyperglycemia in the hospital

Classification of Diabetes

- **Type 1 Diabetes**
- LADA (Latent autoimmune diabetes of adults)
- **Type 2 Diabetes**
  - Ketosis prone diabetes/ Atypical diabetes
- Monogenic Diabetes syndromes (neonatal diabetes and MODY)
- Pancreatic disease (CF and pancreatitis)
- Drug- or chemical-induced diabetes (GC use, HIV/AIDS, post transplantation
- Gestational diabetes
- Autoimmune diabetes – immunotherapy use

Diabetes Care 2022;45(Supplement_1):S17–S38 https://doi.org/10.2337/dc22-S002 4

Type 1 Diabetes (T1D)

Diagnosis and Staging for T1D

- **Autoimmune markers**:
  - Autoantibodies to GAD65 (most common)
  - Islet cell autoantibodies
  - ZnT8 antibodies
  - IA2 autoantibodies
- Rate of β-cell destruction is variable
- Children/adolescents mostly present with hyperglycemic crisis/DKA
- Adults may have more insidious onset, eventually becoming insulin dependent
- LADA vs T1D

Table 2.2—Criteria for the diagnosis of diabetes

FPG ≥126 mg/dL (7.0 mmol/L). Fasting is defined as no caloric intake for at least 8 h.*
OR
2-h PG ≥200 mg/dL (11.1 mmol/L) during OGTT. The test should be performed as described by WHO, using a glucose load containing the equivalent of 75 g anhydrous glucose dissolved in water.*
OR
A1C ≥6.5% (48 mmol/mol). The test should be performed in a laboratory using a method that is NGSP certified and standardized to the DCCT assay.*
OR
In a patient with classic symptoms of hyperglycemia or hyperglycemic crisis, a random plasma glucose ≥200 mg/dL (11.1 mmol/L).

DCCT, Diabetes Control and Complications Trial; FPG, fasting plasma glucose; OGTT, oral glucose tolerance test; WHO, World Health Organization; 2-h PG, 2-h plasma glucose. *In the absence of unequivocal hyperglycemia, diagnosis requires two abnormal test results from the same sample or in two separate test samples.

Diabetes Care 2022;45(Supplement_1):S17–S38 https://doi.org/10.2337/dc22-S002

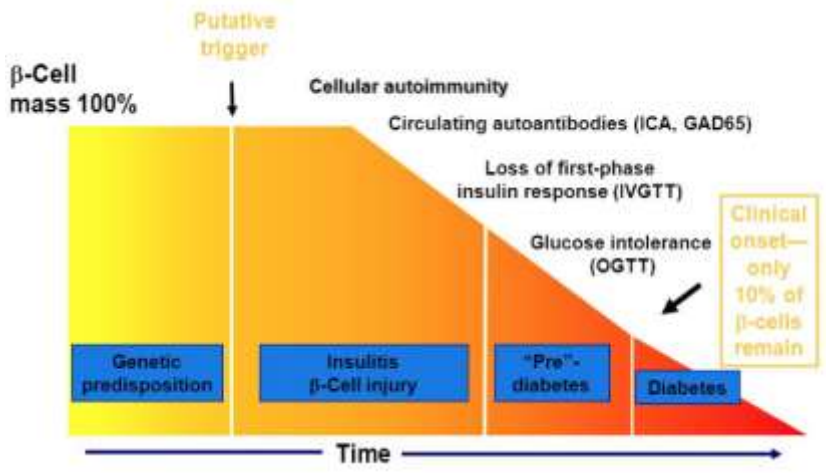
6

Table 2.1—Staging of type 1 diabetes (8,10)

	Stage 1	Stage 2	Stage 3
Characteristics	• Autoimmunity • Normoglycemia • Presymptomatic	• Autoimmunity • Dysglycemia • Presymptomatic	• New-onset hyperglycemia • Symptomatic
Diagnostic criteria	• Multiple autoantibodies • No IGT or IFG	• Multiple autoantibodies • Dysglycemia: IFG and/or IGT • FPG 100–125 mg/dL (5.6–6.9 mmol/L) • 2-h PG 140–199 mg/dL (7.8–11.0 mmol/L) • A1C 5.7–6.4% (39–47 mmol/mol) or ≥10% increase in A1C	• Clinical symptoms • Diabetes by standard criteria

FPG, fasting plasma glucose; IFG, impaired fasting glucose; IGT, impaired glucose tolerance; 2-h PG, 2-h plasma glucose.

Diabetes Care 2022;45(Supplement_1):S17–S38 https://doi.org/10.2337/dc22-S002


Putative trigger
β-Cell mass 100%
Cellular autoimmunity
Circulating autoantibodies (ICA, GAD65)
Loss of first-phase insulin response (IVGTT)
Glucose intolerance (OGTT)
Clinical onset—only 10% of β-cells remain
Genetic predisposition
Insulitis β-Cell injury
"Pre"-diabetes
Diabetes
Time

8

Type 2 Diabetes (T2D)

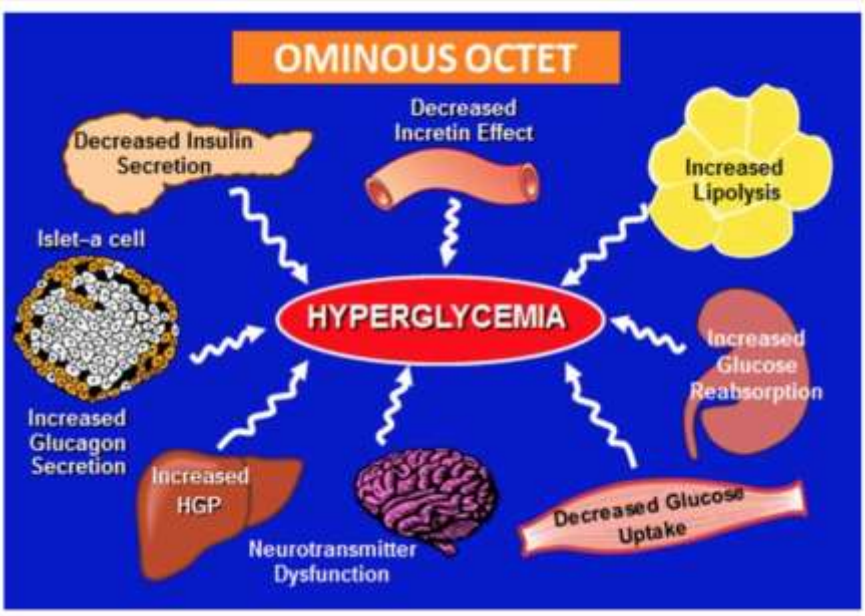
Metabolic Defect in T2D

Insulin resistance, not insulin deficiency is the main issue

- Primary defect:
  - Insulin resistance and beta cell dysfunction
- Secondary defect: to ongoing metabolic milieu
  - Hepatic glucose overproduction
  - Glucagon overproduction
  - Incretin defect
  - Renal glucose reabsorption

DeFronzo et al; Nature Reviews Disease Primers. 2015

10



DeFronzo et al; Nature Reviews Disease Primers. 2015

11

Glycemic targets

- A1c goal < 7.0% for most nonpregnant patients
- Ambulatory glucose profile from CGM: TIR > 70% and time below range < 4%
- Pre-prandial capillary plasma glucose 80-130 mg/dl
- Peak postprandial capillary plasma glucose < 180 mg/dl

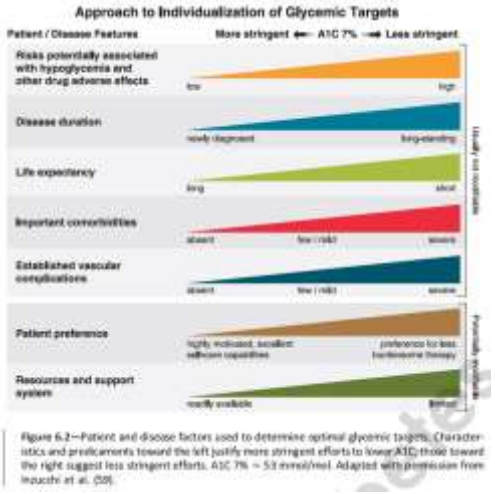


Figure 6.2—Patient and disease factors used to determine optimal glycemic targets. Characteristics and predicaments toward the left justify more stringent efforts to lower A1C; those toward the right suggest less stringent efforts. A1C 7% = 53 mmol/mol. Adapted with permission from Inzucchi et al. (59).

Glycemic Targets: Standards of Medical Care in Diabetes-2022. Diabetes Care. 2022 Jan 1;45(Suppl 1):S83-S96. doi: 10.2337/dc22-S006. PMID: 34964868.

Glycemic Goals in Older Adults (≥ 65 Years Old)

- HbA1c < 7%-7.5%: otherwise healthy and have few coexisting chronic illnesses and intact cognitive and functional status
- HbA1c < 8%-8.5%: multiple coexisting chronic illnesses, cognitive impairment, or functional dependence

Severe comorbidities and limited life expectancy

- HbA1c goal < 8 – 8.5 %

Should be individualized; safety and adherence should be consideration

Glycemic Targets: Standards of Medical Care in Diabetes-2022. Diabetes Care. 2022 Jan 1;45(Suppl 1):S83-S96. doi: 10.2337/dc22-S006. PMID: 34964868.

Assessment of glycemic control

A1c measurements

- 3-month average

- **Limitations**
- Lab error
- Conditions affecting RBC turnover
- Hgb variants
- Does not provide measure for glycemic variability or hypoglycemia

SMBG/CGM

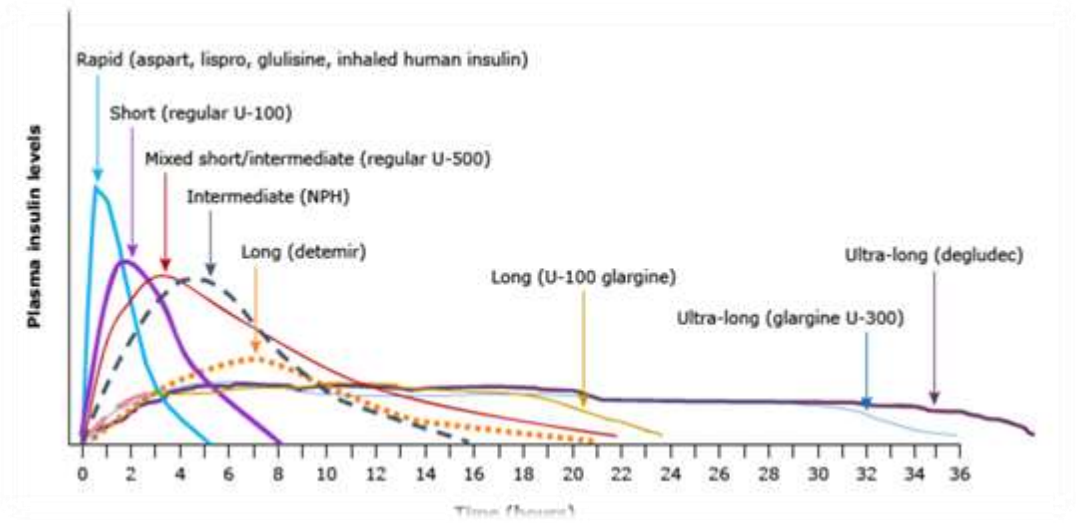
- More personalized assessment of glycemic control
- Accounts for day to day changes and variability of BG
- Assessment of habits
- TIR: useful metric, correlates well with A1C and risk of complications, acceptable end point for clinical trials

- **Limitations:** more expensive, need to wear sensor or fingerpick daily

Management of Diabetes

Insulins

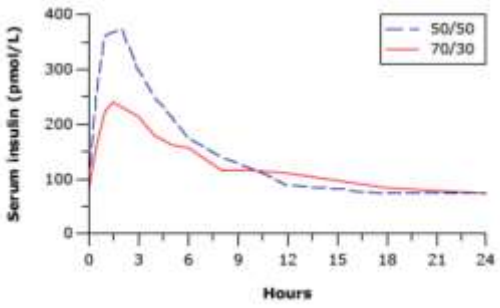
- T1D: essential, life saving, 1st line treatment option
- T2D: not the first line treatment option
  - Added on to oral agents or non-insulin therapies later


Rapid (aspart, lispro, glulisine, inhaled human insulin)
Short (regular U-100)
Mixed short/intermediate (regular U-500)
Intermediate (NPH)
Long (detemir)
Long (U-100 glargine)
Ultra-long (degludec)
Ultra-long (glargine U-300)
Plasma insulin levels
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36

17

Premixed insulins

- Commercially available fixed-ratio pre-mixed insulins (50/50 or 70/30)
- Cheaper than analogs
- Almost never use for treatment in T1D; frequent adjustment for meal time bolus difficult
- Can be used for a type 1 patient non compliant to intensive regimen
- Can be used in T2D with some reasonable effect



Try to avoid if possible

Basal Insulin	Time to onset	Time to peak	Duration of action	Delivery options	Advantages	Disadvantages
NPH	2-4 hr	4-10 hr	12-18 hr	Vial, pen	Cheapest, OTC	Erratic action Marked peak More hypos
Glargine U-100 (LANTUS)	2-4 hr	Flat	20-24 hrs	Vial, pen	Less peak Fewer hypos than NPH in T1D	Expensive
Glargine U-300 (TOUJEO)	N/A	More flat	Upto 36 hrs	Pen only	Flatter and longer than U-100	Expensive Steady state takes 5 days 27% less potent than U-100
Detemir (LEVEMIR)	2-4 hr	Flat	6-24 hrs, mostly 18 hrs	Vial, pen	Flatter than NPH	Expensive Needs twice a day dosing
Degludec U-100 Degludec U-200 (TRESIBA)	N/A	Most flat	> 42 hr	Pen only	Flatter, longer acting Less hypo than glargine U200 pen: 160U/shot	Expensive Steady state takes 3-4 days

19

Prandial insulin	Time to onset	Time to peak	Duration of action	Delivery options	Advantages	Disadvantages
Human regular U-100	30-45 min	3 hr	6-8 hrs	Vial only	Cheapest, OTC	Doesn't match well More delayed hypos
Lispro U-100 **Lispro U-200 (HUMALOG)** **Aspart (NOVOLOG)**	20 min	90-120 min	4-6 hrs	Vial or pen Pen only Vial or pen	Faster than R, matches meal better, less delayed hypo	Expensive
Faster aspart (FIASP)	15-20 min	90-120 min	4-6 hrs	Vial or pen	Less post-meal hyperglycemia	No differences in A1c lowering
Lispro-aabc (Lymjev)	13 min	90-120 min	4.5 hrs	Vial or pen	Less post-meal hyperglycemia	No differences in A1c lowering
Inhaled insulin (AFREZZA)	< 15 min	45-60 min	1.5 hr	Single use cartridges	Faster on and off Matches meal better	Expensive Limited dose intervals C/I - COPD, asthma

20

- **Multiple Daily Insulin (MDI)**
  - Basal coverage with long-acting insulin once or twice day
  - Premeal coverage with rapid-acting insulin used as carb ratio and correctional factor
  - Optimal time to dose prandial insulin depends on pharmacokinetics
  - Individualized t/t plan and Intensive education of patient on dosing of rapid-acting insulin; account for BG, carb intake and activity levels

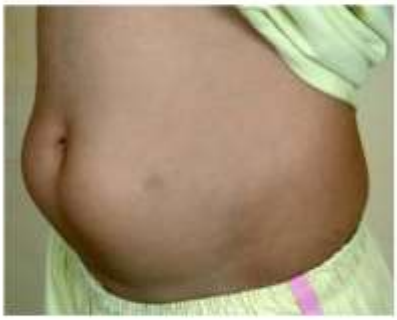
- **Continuous Subcutaneous Insulin Infusion (CSII):**
  - Via insulin pump, modest lowering of A1c and reduced rates of hypoglycemia
  - Pump therapy should be used with CGM whenever possible

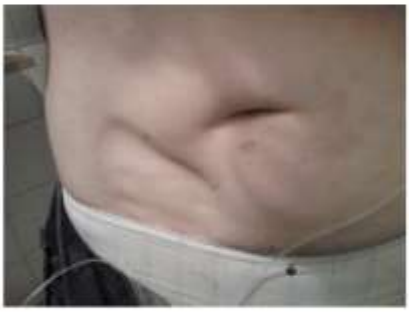
Typical insulin doses: 0.4-1.0 U/kg/day, split 50% as basal and 50% as prandial

Insulin injection techniques

- Correct technique important to optimize glucose control
- Appropriate body areas: abdomen, thigh, buttock, upper arm
  - Subcutaneous, not IM
  - IM injection can lead to unpredictable insulin absorption, more frequent and severe hypoglycemia
- Injection site rotation: to avoid lipohypertrophy/atrophy
  - Can contribute to erratic insulin absorption, increased glycemic variability and more hypoglycemia
  - Examination of insulin injection sites should be done each visit
- Assessment of injection device use and injection technique

Lipohypertrophy & Lipoatrophy





Barola et al; BMJ Case Reports 2017
Kadiyala et al; British Journal of Diabetes 2014

23

Non-insulin therapies

- Metformin
- Sulfonylureas (SU)
- Thiazolidinediones (TZDs)
- Alpha-glucosidase inhibitors
- Dipeptidyl peptidase-4 (DPP-4) inhibitors
- Glucagon like protein-1 (GLP-1) receptor agonists
- Sodium-glucose transport protein-2 (SGLT-2) inhibitors

METFORMIN

- Can be initiated at the time of diabetes diagnosis
- Longstanding safety record, low cost, high efficacy and reasonable tolerability
- **Glycemic Efficacy:** Typical reduction in A1c is in the range of 1 to 2.0%
- Dose can be started at 500 mg once daily and slowly titrated up (after 1-2 weeks) to avoid gastrointestinal (GI) side effects
- Renal dosing for CKD patients
- Adverse events:
  - GI intolerance
  - Lactic acidosis
  - Vitamin B12 deficiency

Feingold KR. Oral and Injectable (Non-Insulin) Pharmacological Agents for the Treatment of Type 2 Diabetes. [Updated 2021 Aug 28]. In: Feingold KR, Anawalt B, Boyce A, et al., editors. Endotext

SULFONYLUREAS (SU)

- Oldest class of oral antidiabetic medication
- Widely used as they are very inexpensive
- Insulin secretagogues
  - Stimulate insulin secretion in the pancreatic beta-cells
- **Glycemic efficacy:** Reduction in A1c of 0.5-1.5%
  - Those with shorter duration of diabetes and residual beta-cell function are more likely to be responsive
- Adverse effects:
  - Hypoglycemia
  - Weight gain

Feingold KR. Oral and Injectable (Non-Insulin) Pharmacological Agents for the Treatment of Type 2 Diabetes. [Updated 2021 Aug 28]. In: Feingold KR, Anawalt B, Boyce A, et al., editors. Endotext

THIAZOLIDINEDIONES (TZD)

- Improve insulin sensitivity by acting on adipose, muscle and liver to increase glucose utilization and decrease glucose production.
- 2 medications available in this class:
  - Rosiglitazone
  - Pioglitazone

- **Glycemic efficacy:** Expected decrease in A1c is approx. 1.0 to 1.5%
- Effective in improving glycemic control in those with significant insulin resistance.

Feingold KR. Oral and Injectable (Non-Insulin) Pharmacological Agents for the Treatment of Type 2 Diabetes. [Updated 2021 Aug 28]. In: Feingold KR, Anawalt B, Boyce A, et al., editors. Endotext

Adverse effects

- **Weight gain**
  - ~ 2 – 3 kg for every 1 percent decrease in A1c
  - Dose related and can be minimized by using lower doses.
- **Fluid Retention**
  - Dose related
- **Congestive Heart Failure**
  - Risk for CHF development is higher if they have a history of cardiovascular disease.
- **Osteoporosis**
  - Increase in Fracture risk, especially women.

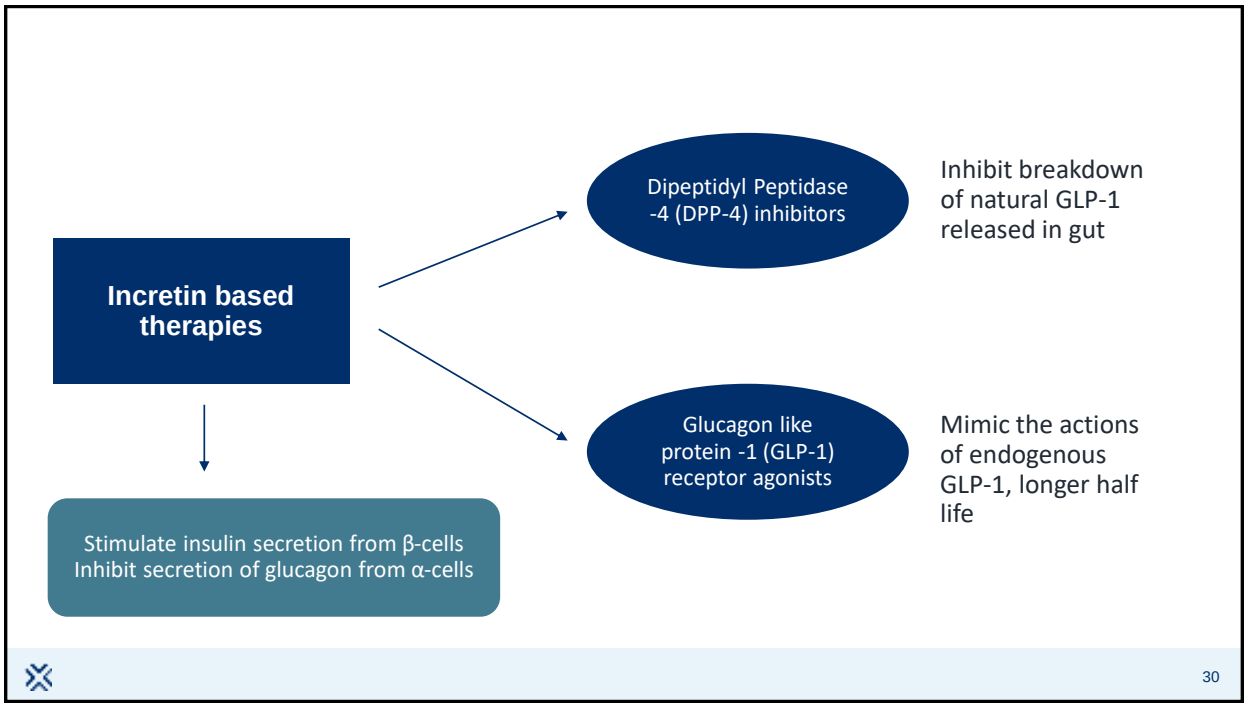
Bladder Cancer

FDA recommends that pioglitazone not be used in diabetic patients with active bladder cancer or a history of bladder cancer

ALPHA-GLUCOSIDASE INHIBITORS

- Inhibit the upper gastrointestinal enzyme (alpha-glucosidase) that convert complex polysaccharide carbohydrates into monosaccharides.
  - Slows the absorption of glucose.
- **Acarbose and Miglitol**
  - Starting dose: 25 mg orally three times daily at start of each meal
  - Maximum dose: 100 mg three times daily with meals.
- Predominant effect on postprandial hyperglycemia.
- **<u>Adverse effects:</u>**
  - **Gastrointestinal**
  - Flatulence, Abdominal discomfort, and/or Diarrhea

Feingold KR. Oral and Injectable (Non-Insulin) Pharmacological Agents for the Treatment of Type 2 Diabetes. [Updated 2021 Aug 28]. In: Feingold KR, Anawalt B, Boyce A, et al., editors. Endotext


Incretin based therapies
Stimulate insulin secretion from β-cells
Inhibit secretion of glucagon from α-cells
Dipeptidyl Peptidase -4 (DPP-4) inhibitors
Inhibit breakdown of natural GLP-1 released in gut
Glucagon like protein -1 (GLP-1) receptor agonists
Mimic the actions of endogenous GLP-1, longer half life
30

Dipeptidyl Peptidase-4 (DPP-4) inhibitors

- Drugs available: Sitagliptin, Saxagliptin, Linagliptin, Alogliptin
- **Glycemic efficacy:** Reduce A1c levels by 0.5 – 1.0 %
  - Effective at lowering post-prandial glucose levels
- **Adverse Effects:**
  - Acute Pancreatitis
  - Increased risk for hospitalization for heart failure: only with *Saxagliptin* in the SAVOR-TIMI 53 study
  - Arthralgias: Discontinue DDP-4 inhibitor if patients develop severe joint pain
- No cardiovascular benefit relative to placebo in CVOTs

Feingold KR. Oral and Injectable (Non-Insulin) Pharmacological Agents for the Treatment of Type 2 Diabetes. [Updated 2021 Aug 28]. In: Feingold KR, Anawalt B, Boyce A, et al., editors. Endotext

	SAVOR TIMI 53	EXAMINE	TECOS	CAROLINA	CARMELINA
Intervention	Saxagliptin/ Placebo	Alogliptin/ Placebo	Sitagliptin/ Placebo	Linagliptin/ Glimepiride	Linagliptin/ Placebo
MACE	Neutral	Neutral	Neutral	Neutral	Neutral
CV Death			N/A		
HF Hospitalization		NS	Neutral	Neutral	NS

Scirica et al; NEJM 2013
White et al; NEJM 2013
Green et al; NEJM 2015

32

Glucagon like protein-1 (GLP-1) receptor agonists

- GLP-1 analogues with longer half lives to achieve supra-physiological levels:
  - Exenatide BID
  - Lixisenatide
  - Liraglutide
  - Dulaglutide
  - Albiglutide
  - Semaglutide
  - Exenatide once weekly
  - Tirzepetide (Combined GLP/GIP)

(*Approved by the FDA in May 2022 for the treatment of Type 2 Diabetes in adults)*

Increase insulin secretion
Decrease satiety
Reduce glucagon secretion
Slow gastric emptying

↓HbA1c (1-2%)
Weight loss

Feingold KR. Oral and Injectable (Non-Insulin) Pharmacological Agents for the Treatment of Type 2 Diabetes. [Updated 2021 Aug 28]. In: Feingold KR, Anawalt B, Boyce A, et al., editors. Endotext

Adverse Effects:

- **Gastrointestinal**
  - Resolve over time
- **Injection site reaction**
  - Rash, erythema
- **Medullary Thyroid cancer**
  - Possible concern in mice studies
  - Not seen with clinical studies in humans
- **Pancreatitis**
- **Retinopathy**
  - Semaglutide in the SUSTAIN 6 trial

Feingold KR. Oral and Injectable (Non-Insulin) Pharmacological Agents for the Treatment of Type 2 Diabetes. [Updated 2021 Aug 28]. In: Feingold KR, Anawalt B, Boyce A, et al., editors. Endotext

GLP-1 RAs Reduce CV risk

	ELIXA Lixisenatide	**LEADER** Liraglutide	**SUSTAIN-6** SQ semaglutide	**EXSCEL** QW exenatide	**HARMONY** Albiglutide	**REWIND** Dulaglutide	**PIONEER 6** Oral semaglutide
3P MACE	NS	↓13%	↓ 26%	NS	↓22%	↓12%	NS
CV Death		↓22%	NS	NS	NS	NS	↓51%
Non fatal stroke		NS	↓ 39%	NS	NS	↓24%	NS
Non fatal MI		NS	NS	NS		NS	NS
All cause death		↓15%		NS			↓49%
HF Hospitalization		NS		NS			

3P MACE = CV death, Non fatal MI, non fatal stroke,

SODIUM-GLUCOSE TRANSPORT PROTEIN 2 (SGLT2) INHIBITORS

SGLT-2 INHIBITORS

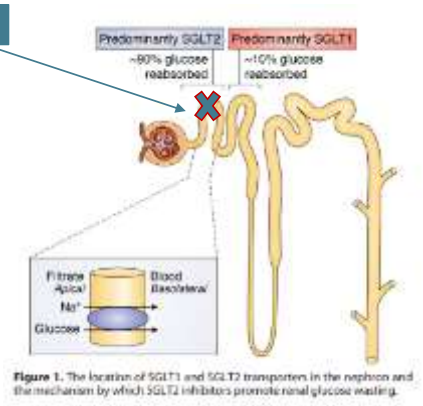


Figure 1. The location of SGLT1 and SGLT2 transporters in the nephron and the mechanism by which SGLT2 inhibitors promote renal glucose wasting.

- The efficacy of SGLT2 inhibitors is dependent on renal function
  - Ability to lower A1c levels diminishes as renal function declines

Glycemic efficacy

- Decrease A1c by 0.4 – 1.1 %
- Lowers both fasting and postprandial glucose levels

Drugs available

- Canagliflozin (Invokana)
- Dapagliflozin (Farxiga)
- Empagliflozin (Jardiance)
- Ertugliflozin (Steglatro)

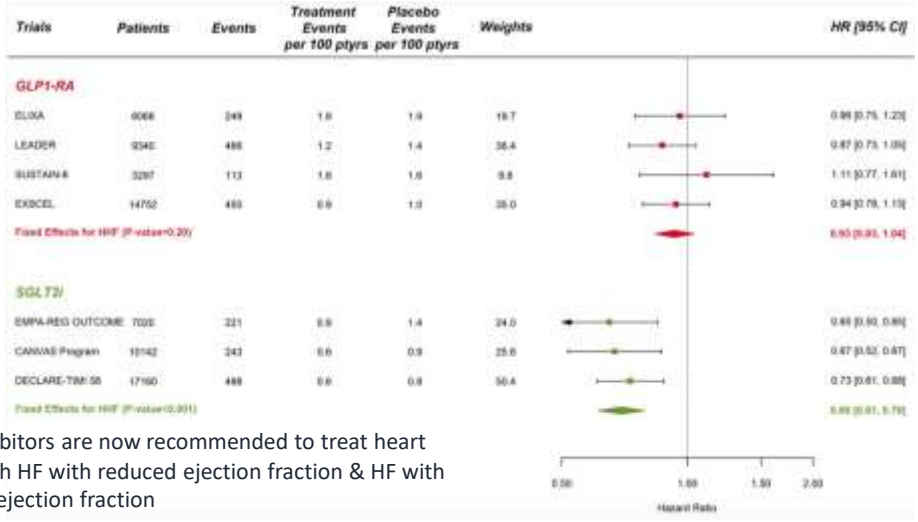
Feingold KR. Oral and Injectable (Non-Insulin) Pharmacological Agents for the Treatment of Type 2 Diabetes. [Updated 2021 Aug 28]. In: Feingold KR, Anawalt B, Boyce A, et al., editors. Endotext

ADVERSE EFFECTS

- **Urinary Tract Infections**
  - Contraindicated in patients with neurogenic bladder and indwelling catheter
- **Genital mycotic infections**
  - Mild and easy to treat
- **Fournier Gangrene:** *necrotizing fasciitis of the perineum*
  - Requires immediate surgical intervention and treatment with broad-spectrum antibiotics
- **Euglycemic Diabetic Ketoacidosis**
  - Blood glucose levels at which ketoacidosis develops with SGLT2 inhibitors may be lower (often < 250 mg/dL) than typically expected for cases of diabetic ketoacidosis
  - May result in a delay in diagnosing DKA
- **Amputations**
  - Canagliflozin was associated with an increased risk of amputations in CANVAS study

Feingold KR. Oral and Injectable (Non-Insulin) Pharmacological Agents for the Treatment of Type 2 Diabetes. [Updated 2021 Aug 28]. In: Feingold KR, Anawalt B, Boyce A, et al., editors. Endotext

SODIUM-GLUCOSE TRANSPORT PROTEIN 2 (SGLT2) INHIBITORS and HEART FAILURE



- SGLT-2 inhibitors are now recommended to treat heart failure, both HF with reduced ejection fraction & HF with preserved ejection fraction

Zelniker et al; Circulation. 2019 Apr 23;139(17):2022-2031

38

WEIGHT LOSS	WEIGHT NEUTRAL	WEIGHT GAIN
GLP-1 Receptor agonists	DDP-4 Inhibitors	Sulfonylureas
SGLT-2 Inhibitors		Thiazolidinediones (TZD)
Metformin		Insulin

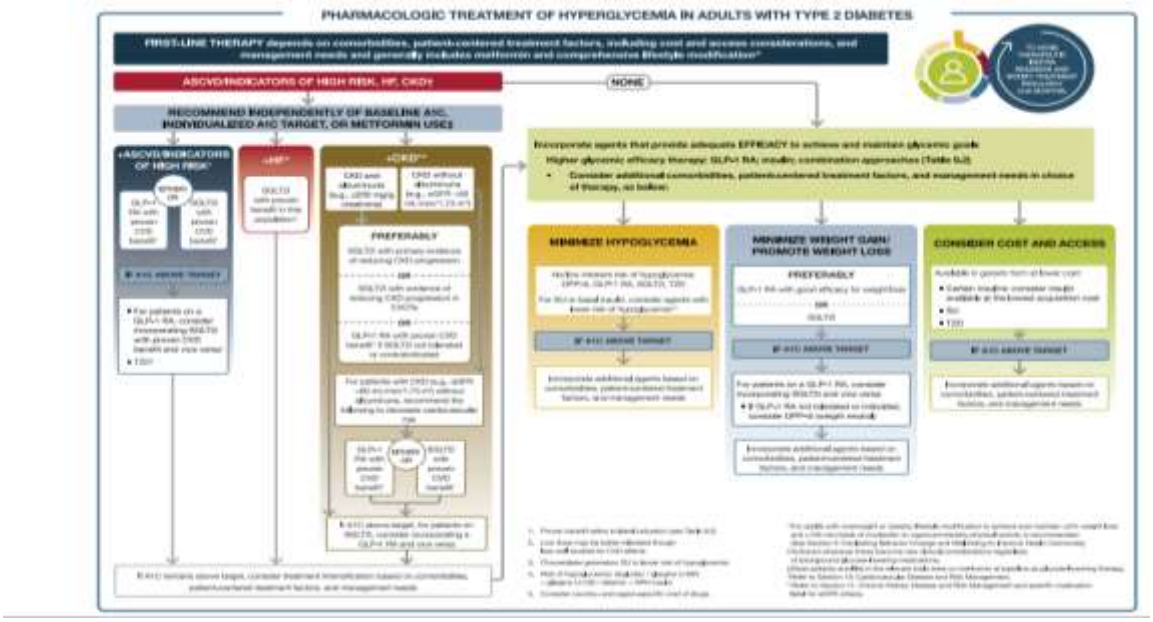
TYPE 2 DM DIABETES: INITIATING PHARMACOTHERAPY

Standards of Medical Care in Diabetes – 2022 Guideline update

- First medication that should be prescribed should ***usually*** be Metformin in addition to comprehensive lifestyle changes.
  - ➢allows for more flexibility than the 2021 ADA recommendation: *"all people should be prescribed metformin"*
- Alternative initial treatment approaches to Metformin is now acceptable depending on several factors, such as:
  1) ***Co-morbidities*****:** atherosclerotic cardiovascular disease (ASCVD) and indications for high ASCVD risk; chronic kidney disease (CKD) and heart failure (HF)
  2) ***Hypoglycemia risk***
  3) ***Effects on body weight***
  4) ***Side effects***
  5) ***Cost***
  6) ***Patient preference***

Pharmacologic Approaches to Glycemic Treatment: Standards of Medical Care in Diabetes-2022. Diabetes Care. 2022 Jan 1;45(Suppl 1):S125-S143. doi: 10.2337/dc22-S009. PMID: 34964831

40



Pharmacologic Approaches to Glycemic Treatment: Standards of Medical Care in Diabetes-2022. Diabetes Care. 2022 Jan 1;45(Suppl 1):S125-S143. doi: 10.2337/dc22-S009. PMID: 34964831

41

Use of technology in diabetes

- Technology is rapidly changing, but there is no “one-size-fits-all” approach to technology use in people with diabetes
- Use of technology should be individualized based on a patient’s needs, desires, skill level, and availability of devices

Diabetes Technology: Standards of Medical Care in Diabetes-2021. Diabetes Care (2021) 44 (Suppl. 1): S85-S99.

42

- Traditional "fingerstick" glucose testing

- Continuous glucose monitoring (CGM)

A. Sensor

B. Transmitter

C. Display device

43

CGM devices

FreeStyle Libre | Guardian Connect | Eversense | G6

Kruger et al. Reference Guide for Integrating Continuous Glucose Monitoring into Clinical Practice. The Diabetes Educator. (2019) 43 (Suppl1): 3S-20S.

ABBOTT FREESTYLE LIBRE

- Flash Glucose Monitor (FGM)
- Factory Calibrated
- 14-day wear following 12-hr warm-up

- No alarms (except libre 2 has alarms for low BG)
- Sensor worn on back of upper arm
- Must scan every 8 hours to maintain a constant stream of data
- Can use receiver or smart phone with Libre View app to scan sensor

https://www.freestyle.abbott/us-en/products/freestyle-libre-2.html

45

Freestyle Libre 3 CGM

Real-time glucose readings are sent every minute to the smartphone app and can be viewed with a quick glance

https://www.freestyle.abbott/us-en/products

DEXCOM G6

Does not need calibration, warm up period of 2 hrs
Has Tylenol blocking, no false low BGs
Data can be uploaded to clarity app (like an icloud)
10 day wear

Sensor + Algorithm

Factory calibrated
10 Day Session
Acetaminophen blocking

Applicator

Push Button
Sensor Applicator

Transmitter

BLE - 20 Foot Range
3 Month Life

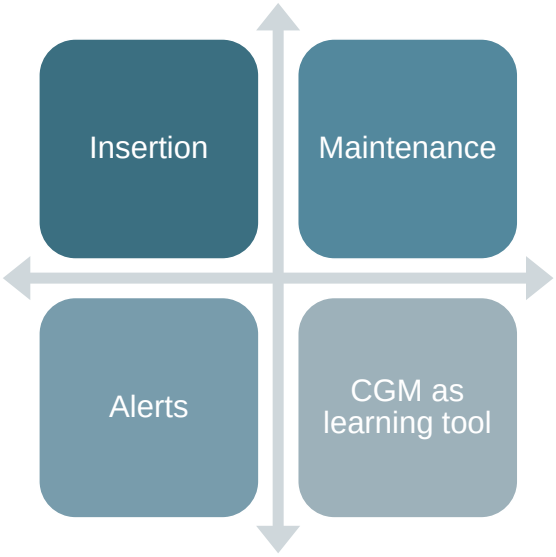
Apps

Dexcom G6 App
Urgent Low Soon Alert
Remote Monitoring

https://www.dexcom.com/products

47

CGM Patient Training



Management of Hyperglycemia in the Hospital

GLYCEMIC TARGETS IN THE HOSPITAL

- NICE-SUGAR trial
  - Higher rates of hypoglycemia and mortality in intensive glycemic control group (80-110) compared to moderate glycemic targets (140-180)
- BG target **140-180** for both critically and non critically ill patients
- BG goal 110-140; for cardiac surgery patients, critically ill post surgical patients (as long as without hypoglycemia)
- BG 180-250; severe comorbidities, frequent hypoglycemia
- BG > 250; terminally ill patients with short life expectancy

Korytkowski et al; JCEM 2022
Diabetes Care 2022;45(Supplement_1):S244–S253 https://doi.org/10.2337/dc22-S016

BEDSIDE BLOOD GLUCOSE MONITORING

Frequency of BG testing

- Patients who are eating: before meals AND bedtime
- Patient not eating: every 4-6 hours
- Patients on IV insulin – every 30 min – 2 hours

Hospitalized for noncritical illness who are at high risk of hypoglycemia, use of real-time continuous glucose monitoring (CGM) with confirmatory bedside point-of-care blood glucose (POC-BG) monitoring is recommended

This does not apply to situations in which CGM may not be accurate:

- Patients with extensive skin infections
- Hypoperfusion
- Hypovolemia
- Those receiving vasoactive or pressor therapy

Korytkowski et al; JCEM 2022
Diabetes Care 2022;45(Supplement_1):S244–S253 https://doi.org/10.2337/dc22-S016

TREATMENT

Critical care setting	Non critical care setting	Enteral nutrition
• Continuous insulin infusions per validated computerized protocols • Adjustment of infusion rate per BG value	• Insulin is the preferred treatment • Scheduled insulin regimens should be used • Non insulin therapies should not be used (with certain exceptions)	• Enteral nutrition with diabetes-specific or nonspecific formulations, neutral protamine Hagedorn (NPH)-based or basal bolus regimens are recommended

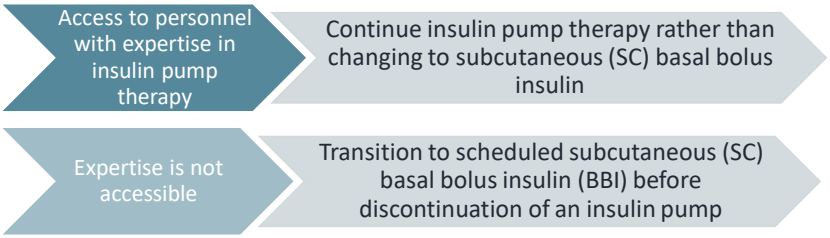
Korytkowski et al; JCEM 2022
Diabetes Care 2022;45(Supplement_1):S244–S253 https://doi.org/10.2337/dc22-S016

Insulin therapy - basics

- In adults with no prior history of diabetes hospitalized for noncritical illness with hyperglycemia
  - Initial therapy with correctional insulin over scheduled insulin therapy (defined as basal or basal/bolus insulin) to maintain glucose targets in the range of 100 to 180 mg
  - For patients with persistent hyperglycemia [POC-BG measurements ≥ 180 mg/dL in a 24-hour period on correctional insulin alone], we suggest the addition of scheduled insulin therapy
- In adults with insulin-treated diabetes prior to admission who are hospitalized for noncritical illness, we recommend continuation of the scheduled insulin regimen (basal/bolus regimen) modified for nutritional status and severity of illness to maintain glucose targets in the range of 100 to 180 mg/dL
- Correctional insulin should be AC/HS or q4-6 hrs **(NOT AS DIRECTED PRN)**
- POC testing and insulin injections should align with meals
- ***Reactive/sliding scale insulin regimens should not be used***

Korytkowski et al; JCEM 2022
Diabetes Care 2022;45(Supplement_1):S244–S253 https://doi.org/10.2337/dc22-S016

PATIENTS WITH INSULIN PUMP



Who are not candidates for inpt use of insulin pump:

- Impaired level of consciousness
- Inability to appropriately adjust pump settings
- Critical illness (intensive care unit care)
- Diabetic ketoacidosis or hyperosmolar hyperglycemic state

Korytkowski et al; JCEM 2022

54

QUESTIONS??

Contact Information

Mailing Address

1000 N. Lincoln Blvd, Suite 2900
Oklahoma City, OK
73104

Email Address

Itivrita-Goyal@ouhsc.edu

Phone Number

405-271-3613