

Outpatient Management of Type 2 DM¹

- Donald Eagerton M.D., F.A.C.P., F.A.C.E.
- October 2016



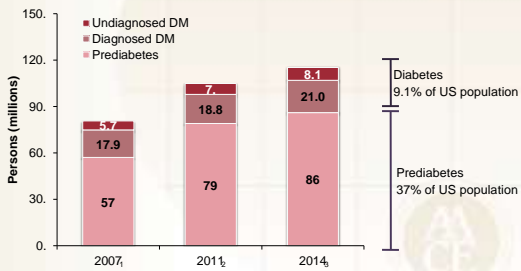
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The Burden of Diabetes



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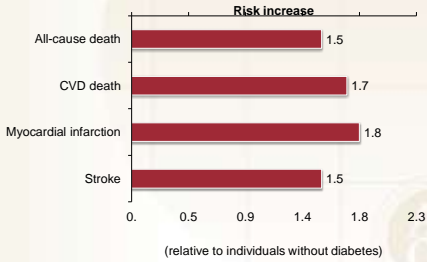
Prevalence of Diabetes and Prediabetes in the United States



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1. CDC. National diabetes fact sheet, 2008. http://www.cdc.gov/diabetes/pubs/pdf/nfnds_2008.pdf.
 2. CDC. National diabetes fact sheet, 2011. http://www.cdc.gov/diabetes/pubs/pdf/nfnds_2011.pdf.
 3. CDC. National diabetes statistics report, 2014. <http://www.cdc.gov/diabetes/pubs/statereport14/national-diabetes-report-web.pdf>

Diabetes and Morbidity and Mortality

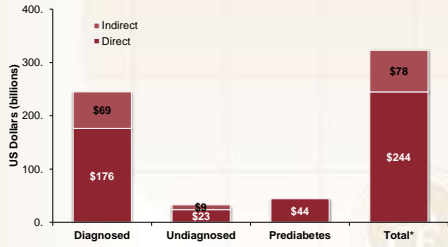


CDC. National diabetes statistics report, 2014. <http://www.cdc.gov/diabetes/pubs/statsreport14/national-diabetes-report-web.pdf>

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Costs of Diabetes

2012 Burden Estimate

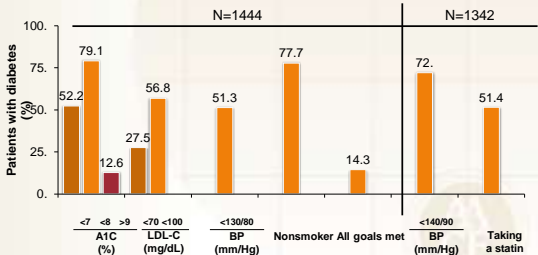


*Includes \$1.3 billion in costs from gestational diabetes. Dall TM, et al. Diabetes Care. 2014;37:3172-3179.

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Goal Achievement in Diabetes

NHANES 2007-2010*

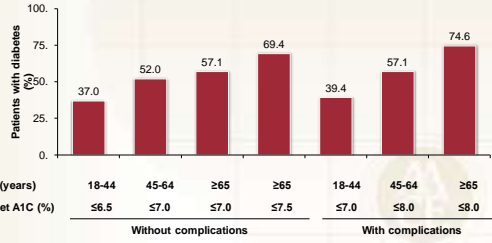


*Data from separate studies. BP, blood pressure; LDL-C, low-density lipoprotein cholesterol; NHANES, National Health and Nutrition Examination Survey. Ali MK, et al. N Engl J Med. 2013;368:1613-1624. Stark Casagrande S, et al. Diabetes Care. 2013;36:2271-2279.

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A1C Achievement by Individualized Target

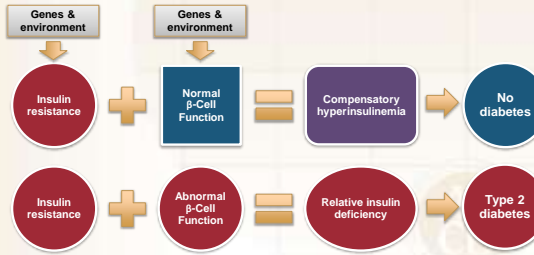
NHANES 2007-2010
(N=1444)



NHANES, National Health and Nutrition Examination Survey.
Ali MK, et al. *N Engl J Med*. 2013;369:1613-1624.

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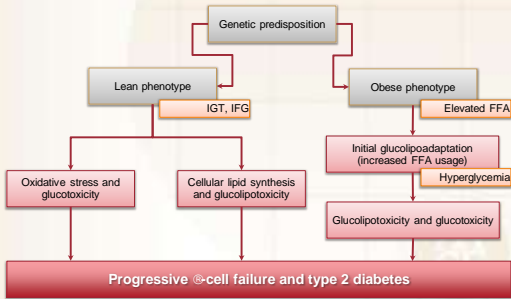
Development of Type 2 Diabetes Depends on Interplay Between Insulin Resistance and β -Cell Dysfunction



Gerich JE. *Mayo Clin Proc*. 2003;78:447-456.

14

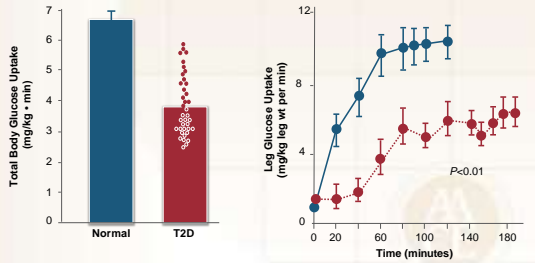
Etiology of β -cell Dysfunction



Poizat V, Robertson RP. *Endocrine Rev*. 2008;29:351-366.

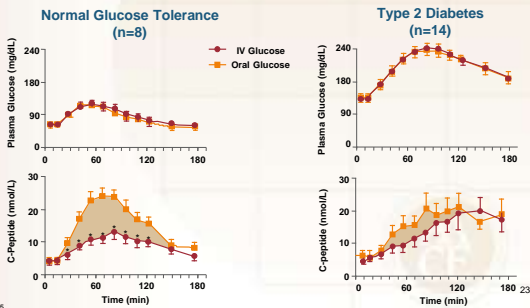
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Defective Insulin Action in Type 2 Diabetes



T2D, type 2 diabetes.
DeFronzo RA. Diabetes. 2009;58:773-796; DeFronzo RA, et al. J Clin Invest. 1985;76:149-155.

The Incretin Effect Is Diminished in Type 2 Diabetes



*Ps. 05.
Nauck M, et al. Diabetologia. 1986;29:46-52.

Actions of GLP-1 and GIP

GLP-1

- Released from L cells in ileum and colon
- Stimulates insulin release from β -cell in a glucose-dependent manner
- Potent inhibition of gastric emptying
- Potent inhibition of glucagon secretion
- Reduction of food intake and body weight
- Significant effects on β -cell growth and survival

GIP

- Released from K cells in duodenum
- Stimulates insulin release from β -cell in a glucose dependent manner
- Minimal effects on gastric emptying
- No significant inhibition of glucagon secretion
- No significant effects on satiety or body weight
- Potential effects on β -cell growth and survival

Drucker DJ. Diabetes Care 2003;26:2929-2940.

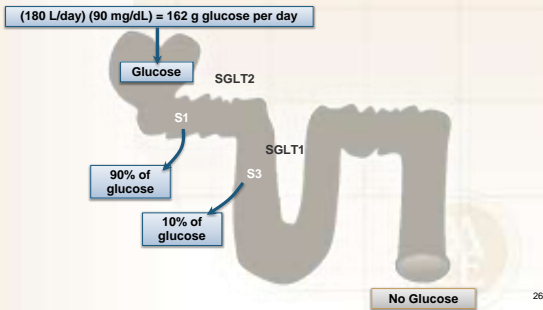
Renal Glucose Reabsorption in Type 2 Diabetes

- Sodium-glucose cotransporters 1 and 2 (SGLT1 and SGLT2) reabsorb glucose in the proximal tubule of kidney
 - Ensures glucose availability during fasting periods
- Renal glucose reabsorption is increased in type 2 diabetes
 - Contributes to fasting and postprandial hyperglycemia
 - Hyperglycemia leads to increased SGLT2 levels, which raises the blood glucose threshold for urinary glucose excretion

Wright EM, et al. *J Intern Med.* 2007;261:32-43.

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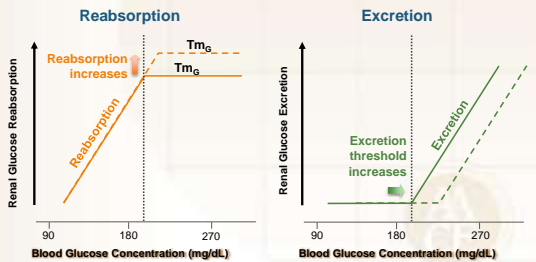
Normal Renal Handling of Glucose



Abdul-Ghani MA, et al. *Endocr Pract.* 2008;14:782-790.

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Increased SGLT2 Protein Levels Change Glucose Reabsorption and Excretion Thresholds

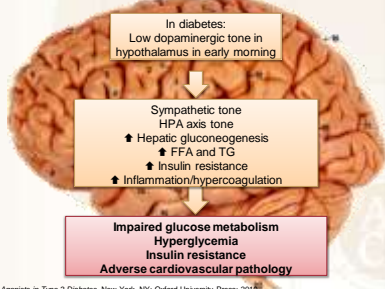


$Tm_{glucose}$ glucose transport maximum.

Abdul-Ghani MA, DeFronzo RA. *Endocr Pract.* 2008;14:782-790.

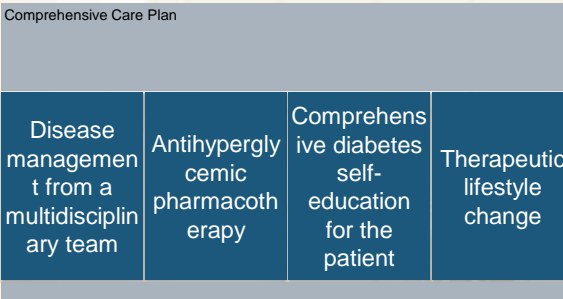
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Hypothalamic Dopaminergic Tone and Autonomic Imbalance



Fonseca V. Dopamine Agonists in Type 2 Diabetes. New York, NY: Oxford University Press; 2010.
 Cicotta AH, In: Hansen B, Shahri E, eds. Insulin Resistance and Insulin Resistance Syndrome. New York, NY: Taylor & Francis; 2002:211-212.

AACE Comprehensive Care Plan



Handelsman YH, et al. Endocr Pract. 2015;21(suppl 1):1-87.

Glycemic Management of Type 2 Diabetes

THERAPEUTIC LIFESTYLE CHANGE

Components of Therapeutic Lifestyle Change

- Healthful eating
- Sufficient physical activity
- Sufficient sleep
- Avoidance of tobacco products
- Limited alcohol consumption
- Stress reduction



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Handelsman YH, et al. *Endocr Pract.* 2015;21(suppl 1):1-87.

AACE Recommendations: Therapeutic Lifestyle Changes

Parameter	Treatment Goal
Weight loss (for overweight and obese patients)	Reduce by 5% to 10%
Physical activity	150 min/week of moderate-intensity exercise (eg, brisk walking) plus flexibility and strength training
Diet	<ul style="list-style-type: none"> • Eat regular meals and snacks; avoid fasting to lose weight • Consume plant-based diet (high in fiber, low calories/glycemic index, and high in phytochemicals/antioxidants) • Understand Nutrition Facts Label information • Incorporate beliefs and culture into discussions • Use mild cooking techniques instead of high-heat cooking • Keep physician-patient discussions informal

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Handelsman YH, et al. *Endocr Pract.* 2015;21(suppl 1):1-87.

AACE Recommendations: Healthful Eating

Carbohydrate	Specify healthful carbohydrates (fresh fruits and vegetables, legumes, whole grains); target 7-10 servings per day Preferentially consume lower-glycemic index foods (glycemic index score <55 out of 100: multigrain bread, pumpernickel bread, whole oats, legumes, apple, lentils, chickpeas, mango, yams, brown rice)
Fat	Specify healthful fats (low mercury/contaminant-containing nuts, avocado, certain plant oils, fish) Limit saturated fats (butter, fatty red meats, tropical plant oils, fast foods) and trans fat; choose fat-free or low-fat dairy products
Protein	Consume protein in foods with low saturated fats (fish, egg whites, beans); there is no need to avoid animal protein Avoid or limit processed meats
Micronutrients	Routine supplementation is not necessary; a healthful eating meal plan can generally provide sufficient micronutrients Chromium; vanadium; magnesium; vitamins A, C, and E; and CoQ10 are not recommended for glycemic control Vitamin supplements should be recommended to patients at risk of insufficiency or deficiency

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Handelsman YH, et al. *Endocr Pract.* 2015;21(suppl 1):1-87.

AACE Recommendations: Medical Nutritional Therapy

- Consistency in day-to-day carbohydrate intake
- Adjusting insulin doses to match carbohydrate intake (eg, use of carbohydrate counting)
- Limitation of sucrose-containing or high-glycemic index foods
- Adequate protein intake
- "Heart-healthy" diets
- Weight management
- Exercise
- Increased glucose monitoring



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Handelsman YH, et al. *Endocr Pract.* 2015;21(suppl 1):1-87.

Glycemic Management of Type 2 Diabetes

ANTIHYPERGLYCEMIC THERAPY



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Noninsulin Agents Available for T2D

Class	Primary Mechanism of Action	Agent(s)	Available as
α-Glucosidase inhibitors	Delay carbohydrate absorption from intestine	Acarbose Miglitol	Precose or generic Glyset
	Decrease glucagon secretion Slow gastric emptying	Pramlintide	Symlin
Amylin analogue	Increase satiety Decrease HGP	Metformin	Glucophage or generic
	Increase glucose uptake in muscle Decrease HGP?	Colesevelam	WelChol
Bile acid sequestrant	Increase incretin levels?	Alogliptin Linagliptin Saxagliptin Sitagliptin	Nesina Tradjenta Onglyza Januvia
	Increase glucose-dependent insulin secretion Decrease glucagon secretion	Bromocriptine	Cycloset
Dopamine-2 agonist	Activates dopaminergic receptors	Nateglinide Repaglinide	Starlix or generic Prandin

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DPP-4 inhibitors: incretinase, HGP, hepatic glucose production
 Gabbler AJ, et al. *Endocr Pract.* 2015;21(suppl 1):88-147.
 Inzucchi SE, et al. *Diabetes Care.* 2015;38:140-149.
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Noninsulin Agents Available for T2D

Class	Primary Mechanism of Action	Agent(s)	Available as
GLP-1 receptor agonists	<input type="checkbox"/> Increase glucose-dependent insulin secretion	Albiglutide	Tanzeum
	<input type="checkbox"/> Decrease glucagon secretion	Dulaglutide	Trulicity
	<input type="checkbox"/> Slow gastric emptying	Exenatide	Byetta
	<input type="checkbox"/> Increase satiety	Exenatide XR Liraglutide	Bydureon Victoza
SGLT2 inhibitors	<input type="checkbox"/> Increase urinary excretion of glucose	Canagliflozin Dapagliflozin Empagliflozin	Invokana Farxiga Jardiance
	<input type="checkbox"/> Increase insulin secretion	Glimepiride	Amaryl or generic
		Glipizide Glyburide	Glucotrol or generic DiaBeta, Glynase, Micronase, or generic
Thiazolidinediones	<input type="checkbox"/> Increase glucose uptake in muscle and fat	Pioglitazone	Actos
	<input type="checkbox"/> Decrease HGP	Rosiglitazone	Avandia

GLP-1, glucagon-like peptide; HGP, hepatic glucose production; SGLT2, sodium glucose cotransporter 2.
 Garber AJ, et al. *Endocr Pract*. 2015;21:439-447.
 Inzucchi SE, et al. *Diabetes Care*. 2015;38:140-149.

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Pharmacokinetics of Available Insulins

Agent	Onset (h)	Peak (h)	Duration (h)	Considerations
NPH	2-4	4-10	10-16	Greater risk of nocturnal hypoglycemia compared to insulin analogs
Basal Glargine 300 Detemir	-1-4	No pronounced peak*	Up to 24†	Less nocturnal hypoglycemia compared to NPH
Basal-Prandial Regular U-500	≤0.5	-2-3	12-24	<input type="checkbox"/> Inject 30 min before a meal <input type="checkbox"/> Indicated for highly insulin resistant individuals <input type="checkbox"/> Use caution when measuring dosage to avoid inadvertent overdose
Prandial Regular	-0.5-1	-2-3	Up to 8	<input type="checkbox"/> Must be injected 30-45 min before a meal <input type="checkbox"/> Injection with or after a meal could increase risk for hypoglycemia
Prandial Aspart Glulisine	<0.5	-0.5-2.5	-3-5	<input type="checkbox"/> Can be administered 0-15 min before a meal <input type="checkbox"/> Less risk of postprandial hypoglycemia compared to regular insulin

* Exhibits "lag phase" in high dosages.
 † Duration of action.
 NPH, Neutral Protamine Hagedorn.
 Moghissi E et al. *Endocr Pract*. 2013;19:526-535. Humulin R U-500 (concentrated) insulin prescribing information. Indianapolis: Lilly USA, LLC.

Effects of Agents Available for T2D

	Met	GLP1RA	SGLT2i	DPP4i	TZD	AGI	Coles	BCR-QR	SU/ Glinide	Insulin	Pram
PPG lowering	Mod	Mild to mod*	Mod	Mild	Mod	Neutral	Mild	Neutral	SU: mod Glinide: mild	Mod to marked (basal insulin or premixed)	Mild
PPG lowering	Mild	Mod to marked	Mild	Mod	Mild	Mod	Mild	Mild	Mod	Mod to marked (short-acting insulin or premixed)	Mod to marked

AGI = α-glucosidase inhibitors; BCR-QR = bromocriptine quick release; Coles = colesvelam; DPP4i = dipeptidyl peptidase 4 inhibitors; PPG = fasting plasma glucose; GLP1RA = glucagon-like peptide 1 receptor agonists; Met = metformin; Mod = moderate; PPG = postprandial glucose; SGLT2i = sodium-glucose cotransporter 2 inhibitors; SU = sulfonylureas; TZD = thiazolidinediones.
 *Mild: albiglutide and exenatide; moderate: dulaglutide, exenatide extended release, and liraglutide.
 Handelsman YH, et al. *Endocr Pract*. 2015;21(suppl 1):1-87.

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Effects of Agents Available for T2D

	Met	GLP1RA	SGLT2i	DPP4i	TZD	AGI	Coles	BCR-QR	SU/ Glinide	Insulin	Pram
NAFLD benefit [†]	Mild	Mild	Neutral	Neutral	Mod	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Hypoglycemia	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	SU: mod to severe Glinide: mild to mod	Mod to severe*	Neutral
Weight	Slight loss	Loss	Loss	Neutral	Gain	Neutral	Neutral	Neutral	Gain	Gain	Loss

AGI = α-glucosidase inhibitors; BCR-QR = bromocriptine quick release; Coles = colesvelam; DPP4i = dipeptidyl peptidase 4 inhibitors; GLP1RA = glucagon-like peptide 1 receptor agonists; Met = metformin; Mod = moderate; NAFLD, nonalcoholic fatty liver disease; SGLT2i = sodium-glucose cotransporter 2 inhibitors; SU = sulfonylureas; TZD = thiazolidinediones.

*Especially with short/rapid-acting or premixed.

Handelsman YH, et al. *Endocr Pract.* 2015;21(suppl 1):1-87.

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Effects of Agents Available for T2D

	Met	GLP1RA	SGLT2i	DPP4i	TZD	AGI	Coles	BCR-QR	SU/ Glinide	Insulin	Pram
Renal impairment/ GU	Contra- indicated in stage 3B, 4, 5 CKD	Exenatid e contra- indicated C/Cr <30 mg/mL	GU infection risk	Dose adjust- ment (except lina- gipitin)	May worsen fluid retention	Neutral	Neutral	Neutral	Increase d risks of hypo- glycemia and fluid retention	Increase d risks of hypo- glycemia and fluid retention	Neutral
GI adverse effects	Mod	Mod*	Neutral	Neutral*	Neutral	Mod	Mild	Mod	Neutral	Neutral	Mod
CHF	Neutral	Neutral	Neutral	Neutral†	Mod	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
CVD	Possible benefit	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral	Safe	?	Neutral	Neutral
Bone	Neutral	Neutral	Bone loss	Neutral	Mod bone loss	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral

AGI = α-glucosidase inhibitors; BCR-QR = bromocriptine quick release; Coles = colesvelam; CHF = congestive heart failure; CVD = cardiovascular disease; DPP4i = dipeptidyl peptidase 4 inhibitors; GI = gastrointestinal; GLP1RA = glucagon-like peptide 1 receptor agonists; GU = genitourinary; Met = metformin; Mod = moderate; SGLT2i = sodium-glucose cotransporter 2 inhibitors; SU = sulfonylureas; TZD = thiazolidinediones.

*Caution in labeling about pancreatitis.

†Caution: possibly increased CHF hospitalization risk seen in CV safety trial.

Handelsman YH, et al. *Endocr Pract.* 2015;21(suppl 1):1-87.

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Monotherapy, Dual Therapy, and Triple Therapy for T2D

Monotherapy*	Dual therapy*	
	Metformin (or other first-line agent) plus	First- and second-line agent plus
Metformin	GLP1RA	GLP1RA
GLP1RA	SGLT2i	SGLT2i
SGLT2i	DPP4i	TZD†
DPP4i	TZD†	Basal insulin†
AGI	Basal insulin†	DPP4i
TZD†	Colesevelam	Colesevelam
SU/glinide‡	BCR-QR	BCR-QR
	AGI	AGI
	SU/glinide‡	SU/glinide‡

AGI = α-glucosidase inhibitors; GLP1RA = glucagon-like peptide 1 receptor agonists; SU = sulfonylureas; TZD = thiazolidinediones.

*Intensify therapy when needed, based on clinical judgment, including consideration of adverse events, and/or the possibility of benefits beyond glucose-lowering.

†Use with caution.

Handelsman YH, et al. *Endocr Pract.* 2015;21(suppl 1):1-87.

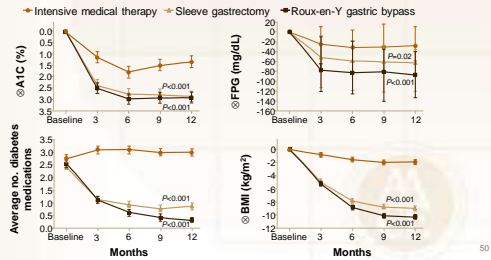
Glycemic Management of Type 2 Diabetes

SURGICAL INTERVENTION

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Surgical Intervention in Type 2 Diabetes

STAMPEDE Trial (n=150)



STAMPEDE. Surgical Treatment and Medications Potentially Eradicate Diabetes Efficiently. Schauer PR, et al. N Engl J Med 2012;366:1567-1576.

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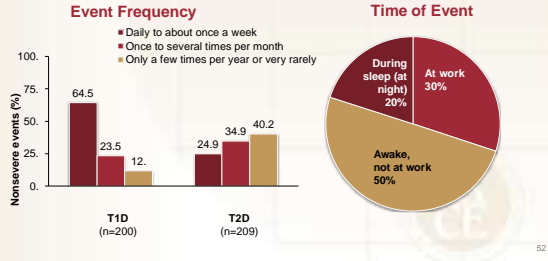
Glycemic Management of Type 2 Diabetes

SAFETY CONCERNS: HYPOGLYCEMIA

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How Often and When Does Nonsevere Hypoglycemia Occur in Diabetes?

Internet-Based Patient Survey



T1D, type 1 diabetes; T2D, type 2 diabetes. Brod M, et al. Value Health. 2011;14:665-671.

Type 2 Diabetes Pathophysiology: Origins of Hypoglycemia

	Defect
β-cells	Increased insulin availability due to use of secretagogues or exogenous insulin
Liver	Suppressed hepatic glucose production due to impaired counter-regulatory response
Skeletal muscle	Increased glucose uptake due to exercise
α-cells	Suppressed glucagon due to impaired counter-regulatory response
Brain	Hypoglycemia unawareness

Cryer PE. Am J Physiol. 1993; 264(2 Pt 1):E149-E155.

Hypoglycemia: Risk Factors

Patient Characteristics	Behavioral and Treatment Factors
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- Older age
- Female gender
- African American ethnicity
- Longer duration of diabetes
- Neuropathy
- Renal impairment
- Previous hypoglycemia

- Missed meals
- Elevated A1C

Miller ME, et al. BMJ. 2010 Jan 8;340:b6444. doi: 10.1136/bmj.b6444.

Consequences of Hypoglycemia

- Cognitive, psychological changes (eg, confusion, irritability)
- Accidents
- Falls
- Recurrent hypoglycemia and hypoglycemia unawareness
- Refractory diabetes
- Dementia (elderly)
- CV events
 - Cardiac autonomic neuropathy
 - Cardiac ischemia
 - Angina
 - Fatal arrhythmia

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Handelsman YH, et al. *Endocr Pract.* 2015;21(suppl 1):1-87.

Symptoms of Hypoglycemia

Classification	Blood Glucose Level (mg/dL)	Typical Signs and Symptoms
Mild hypoglycemia	~50-70	• <i>Neurogenic: palpitations, tremor, hunger, sweating, anxiety, paresthesia</i>
Moderate hypoglycemia	~50-70	• <i>Neuroglycopenic: behavioral changes, emotional lability, difficulty thinking, confusion</i>
Severe hypoglycemia	<50*	• <i>Severe confusion, unconsciousness, seizure, coma, death</i> • <i>Requires help from another individual</i>

*Severe hypoglycemia symptoms should be treated regardless of blood glucose level.

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Handelsman YH, et al. *Endocr Pract.* 2015;21(suppl 1):1-87.

Hypoglycemia: Clinical Consequences

Acute

- Symptoms (sweating, irritability, confusion)
- Accidents
- Falls

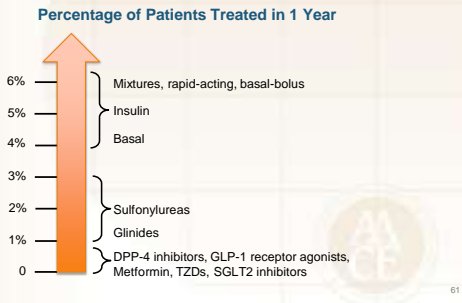
Long-term

- Recurrent hypoglycemia and hypoglycemia unawareness
- Refractory diabetes
- Dementia (elderly)
- CV events
 - Cardiac autonomic neuropathy
 - Cardiac ischemia
 - Fatal arrhythmia
 - Angina

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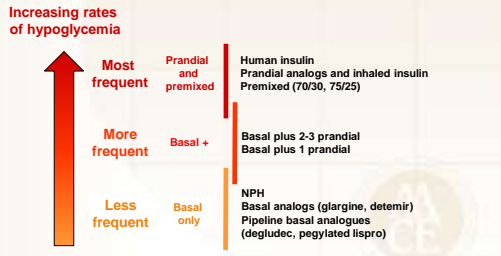
Handelsman YH, et al. *Endocr Pract.* 2015;21(suppl 1):1-87.

Frequency of Severe Hypoglycemia With Antihyperglycemic Agents



Moghissi E, et al. *Endocr Pract*. 2013;19:526-535.

Relative Rates of Severe Hypoglycemia with Insulin



Moghissi E, et al. *Endocr Pract*. 2013;19:526-535.

Glycemic Management of Type 2 Diabetes

SAFETY CONCERNS: WEIGHT

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Antidiabetic Agents and Weight

Class	Agent(s)	Weight Effect
Amylin analog	Pramlintide	↓
Biguanide	Metformin	↓
GLP-1 receptor agonists	Albiglutide, dulaglutide, exenatide, exenatide XR, liraglutide	↓
SGLT-2 inhibitors	Canagliflozin, dapagliflozin, empagliflozin	↓
α-Glucosidase inhibitors	Acarbose, miglitol	↔
Bile acid sequestrant	Colesevelam	↔
DPP-4 inhibitors	Alogliptin, linagliptin, saxagliptin, sitagliptin	↔
Dopamine-2 agonist	Bromocriptine	↔
Glinides	Nateglinide, repaglinide	↑
Sulfonylureas	Glimepiride, glipizide, glyburide	↑
Insulin	Aspart, detemir, glargine, glulisine, lispro, NPH, regular, inhaled	↑↑
Thiazolidinediones	Pioglitazone, rosiglitazone	↑↑

* Risk of additional weight gain must be balanced against the benefits of the agent

- Sulfonylureas may negate weight loss benefits of GLP-1 receptor agonists or metformin
- Insulin should not be withheld because of the risk of weight gain

Garber AJ, et al. *Endocr Pract*. 2015;21:438-447.
 Inzucchi SE, et al. *Diabetes Care*. 2015;38:140-149.
 Handelsman YH, et al. *Endocr Pract*. 2015;21(suppl 1):1-87.

Glycemic Management of Type 2 Diabetes

SAFETY CONCERNS: CANCER RISK

DM and Cancer

- Screen obese individuals with DM more frequently and rigorously for certain cancers
 - Endometrial, breast, hepatic, bladder, pancreatic, colorectal cancers
- Increased BMI (≥25 kg/m²) also increases risk of some cancers
 - Strong associations: endometrial, gall bladder, esophageal, renal, thyroid, ovarian, breast, and colorectal cancer
 - Weaker associations: leukemia, malignant and multiple melanoma, pancreatic cancer, non-Hodgkin lymphoma
- To date, no definitive relationship has been established between specific hyperglycemic agents and increased risk of cancer or cancer-related mortality
 - Consider avoiding medications considered disadvantageous to specific cancers in individuals at risk for or with a history of that cancer

Handelsman YH, et al. *Endocr Pract*. 2015;21(suppl 1):1-87.

DM and Occupational Hazards

- Commercial drivers at high risk for developing T2D
 - Screen as appropriate
 - Encourage healthy lifestyle change
- Be aware of management requirements and use agents with reduced risk of hypoglycemia in patients with occupations that could put others at risk, such as (not inclusive):
 - Commercial drivers
 - Pilots
 - Anesthesiologists
 - Commercial or recreational divers



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Handelsman YH, et al. *Endocr Pract.* 2015;21(suppl 1):1-87.

Risk Considerations for Religious/Cultural Fasting

Main Risks of Fasting	
	<ul style="list-style-type: none"> • Hypoglycemia • Hyperglycemia • Diabetic ketoacidosis • Dehydration and thrombosis
Risk Category	Features
Low	<ul style="list-style-type: none"> <input type="checkbox"/> Glycemia well-controlled with antihyperglycemic agent that does not cause hypoglycemia (eg, metformin, thiazolidinedione, DPP-4 inhibitor, GLP-1 receptor agonist) <input type="checkbox"/> Otherwise healthy
Moderate	<ul style="list-style-type: none"> <input type="checkbox"/> Glycemia well-controlled with glinides <input type="checkbox"/> Moderate hyperglycemia (A1C 7.5-9.0%), renal insufficiency, cardiovascular complications, and/or other comorbid conditions
High	<ul style="list-style-type: none"> <input type="checkbox"/> Living alone, especially if taking sulfonylureas, insulin, or drugs that affect mentation <input type="checkbox"/> Elderly, especially with poor health <input type="checkbox"/> History of recurrent hypoglycemia, hypoglycemia unawareness, or episode of severe hypoglycemia within 3 months prior to Ramadan <input type="checkbox"/> Poor glycemic control
Very high	<ul style="list-style-type: none"> <input type="checkbox"/> Ketoacidosis or hyperosmotic hyperglycemic coma within 3 months prior to Ramadan <input type="checkbox"/> Acute illness or chronic dialysis

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Al-Arouj M, et al.

Glycemic Management During Religious/Cultural Fasting

- Frequent glucose monitoring—break fast immediately if patient has:
 - Hypoglycemia
 - SMBG <70 mg/dL while taking insulin or sulfonylureas
 - SMBG <60 mg/dL while on other therapies
 - Hyperglycemia: >300 mg/dL
- Healthful eating before and after each fasting period
 - Complex carbohydrates prior to fast
 - Avoid ingesting high-carbohydrate, high-fat foods when breaking fast
- Avoid excessive physical activity but maintain normal exercise routines
- Avoid fasting while ill



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Al-Arouj M, et al. *Diabetes Care.* 2005;28:2305-2311.