Pharmacotherapy: Insulin Therapy

1415 - 1515
Part Two: 1530-1630
7 April 2020

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Presenter

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Agency: Air Force

Diabetes Center of Excellence

JBSA-Wilford Hall Ambulatory Surgical Center

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Learning Objectives

At the conclusion of this knowledge-based activity, participants will be able to:

1. Outline the role of insulin in treating/managing PWD
2. Compare the types of insulin available
3. Analyze the strategies for dosing and titrating insulin

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Key Takeaways

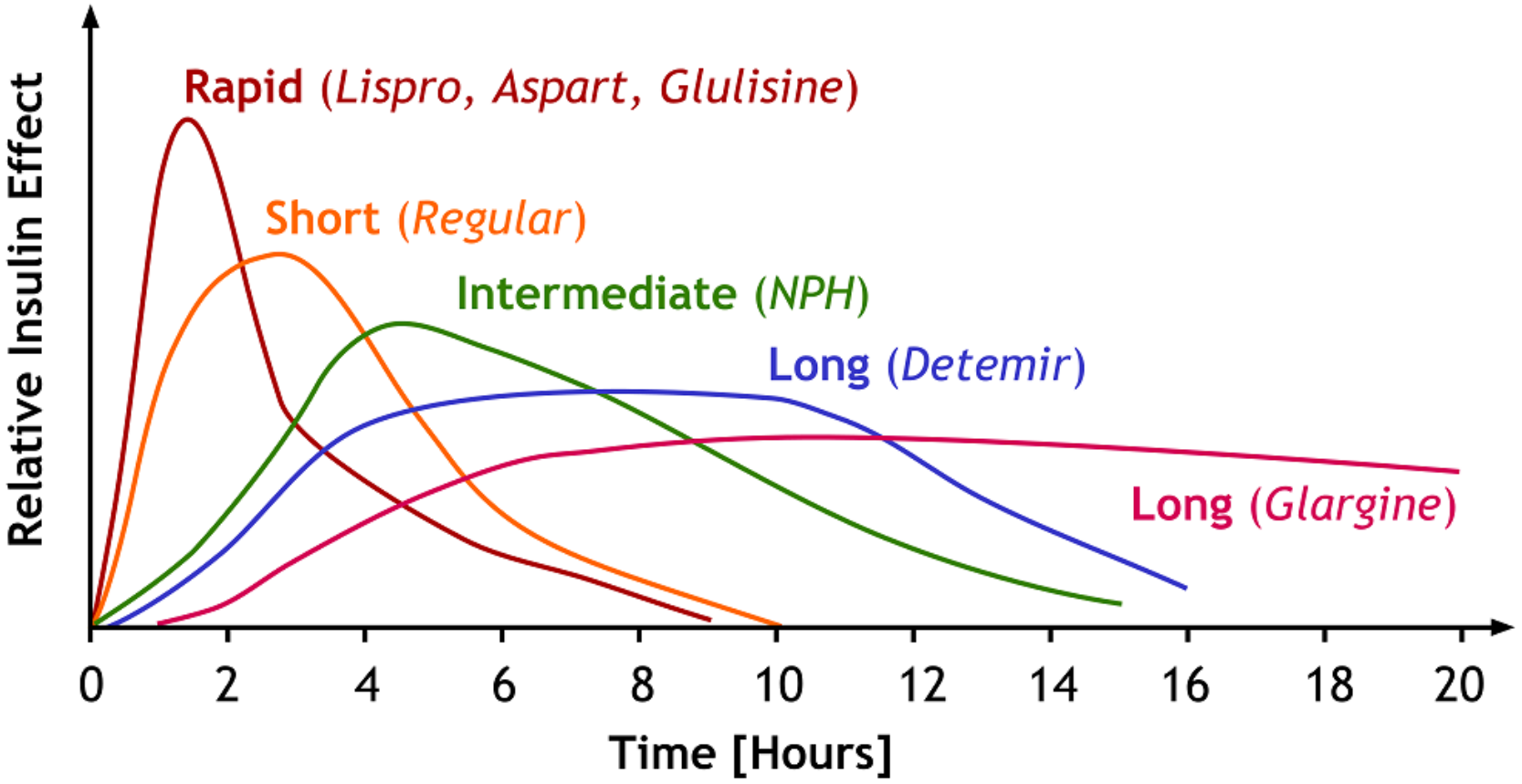
- Different insulins vary by concentration and various aspects of timing
- Patients can take 1 or 2 types of insulin
- Insulin is not a punishment for bad behavior
- Long acting insulin covers basal needs
- Rapid or short-acting insulin covers the glycemic response of food patients are about to eat or corrects for high blood sugars

When to Start Insulin

- Give insulin to patients with T1DM because they have absolute insulin deficiency
- For most patients with T2DM (insulin resistance with relative insulin deficiency), insulin therapy is usually 4th line unless
  - Initial A1c ≥10
  - A1c >2% above target
  - Markedly symptomatic
  - Not at goal with maximal non-insulin therapy

American Diabetes Association. (2020)

Insulin Classes



Komorniczak, M. (2014).

Which of the Following is True?

A. Aspart (Novolog ®) is the most common insulin used intravenously
B. Aspart (Novolog ®) should be given 5-10 minutes prior to mealtime
C. 50 units of Regular U500 insulin is equivalent to 250 units of Regular U100 insulin
D. Degludec (Tresiba®) has same PK/PD as glargine U100

Which of the following is true?

A. Aspart (Novolog ®) is the most common insulin used intravenously

B. **Aspart (Novolog ®) should be given 5-10 minutes prior to mealtime**

C. 50 units of Regular U500 insulin is equivalent to 250 units of Regular U100 insulin

D. Degludec (Tresiba®) has same PK/PD as glargine U100

Ultra Rapid–acting Insulin

Ultra Rapid acting

- Aspart (*Fiasp*®)
- Afrezza® (insulin human)

https://diatribe.org/

http://www.thesavvydiabetic.com/a-do-it-yourself-afrezza-challenge-by-jessica-ching/

Properties	
Onset	12-18 minutes 12 minutes
Peak	1-2 hours 35-55 min
Duration	5-7 hours 1.5-3 hours

Clinical Pearls

- Slightly faster onset than rapid acting

American Diabetes Association. (2015)

Rapid–Acting Insulin

Rapid acting

- Aspart (*NovoLog®*)
- Lispro (*Humalog®*, Humalog® *U200*)
- Glulisine (*Apidra®*)

https://www.pharmacytimes.com/publications/issue/2008/2008-05/2008-05-8536

https://www.novologpro.com/

Properties	
Onset	12-18 minutes
Peak	1-2 hours
Duration	3-5 hours

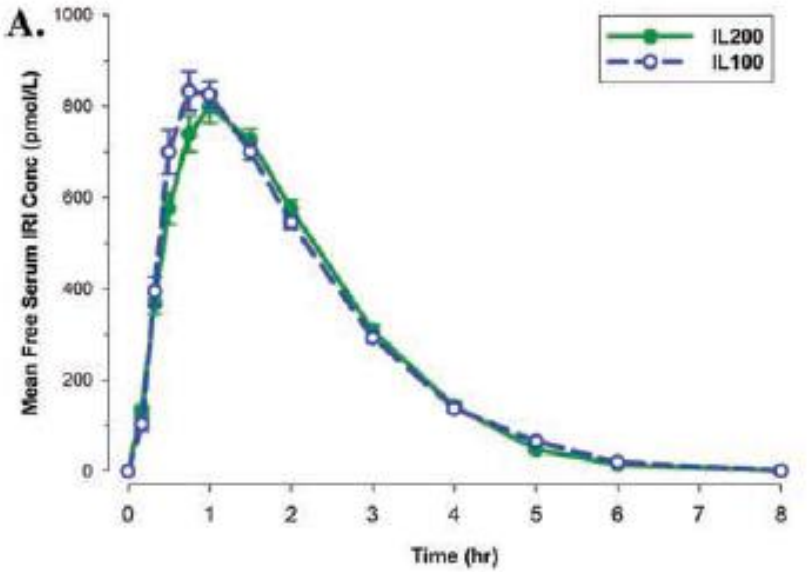
Clinical Pearls

- Use for mealtime coverage
- If skipping a meal, omit mealtime dose
- Also use for correction insulin

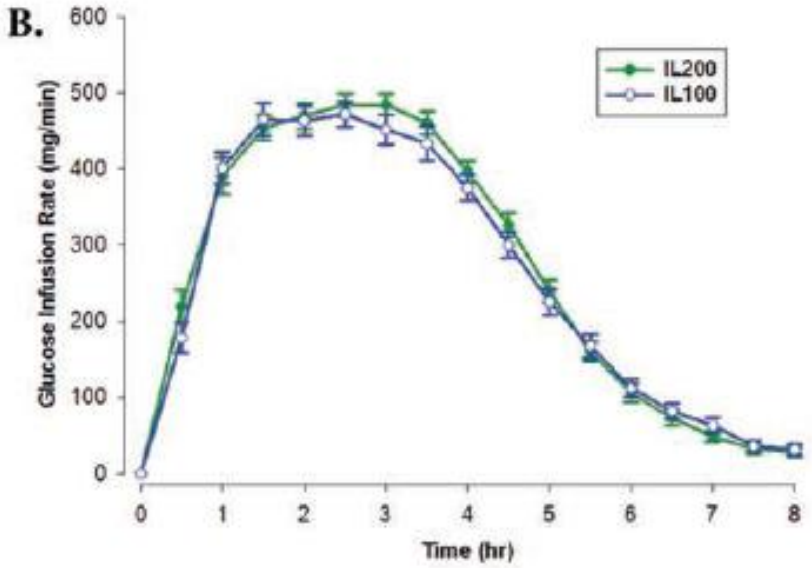
American Diabetes Association. (2015)

Lispro U200

- Lispro U100/U200
  - Onset – 5-15 minutes
  - Peak – 30-90 minutes
  - Duration of action – 5 hours
  - PD/PK profiles bioequivalent



https://www.humalog.com/hcp/humalog-u200/



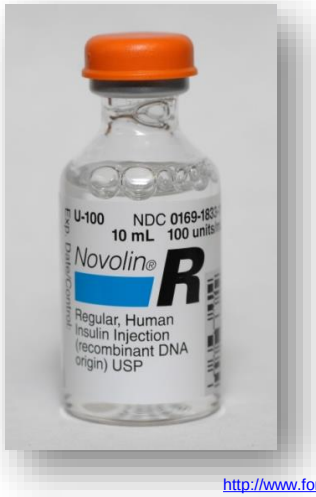
https://www.medicines.org.uk/emc/product/3725/smpc

American Diabetes Association. (2015)

Short-Acting Insulin

Short acting

- Regular (*Novolin R®*)
- Regular (*Humulin R®*)



http://www.foracare.com/Diabetes-Medication.html

Properties	
Onset	15-30 minutes
Peak	2-5 hours
Duration	4-12 hours

Clinical Pearls

- Most common IV insulin
- Approved for pregnancy
- Appropriate for those with gastroparesis

American Diabetes Association. (2015)

Intermediate-Acting Insulin

Intermediate acting

- NPH (*Novolin N®*)
- NPH (*Humulin N®*)

http://www.foracare.com/Diabetes-Medication.html

http://www.diabeticlivingonline.com/medication/insulin/how-to-inject-insulin?page=1

Properties	
Onset	1-2 hours
Peak	4-12 hours
Duration	14-24 hours

Clinical Pearls

- Cloudy appearance
- Mix until uniform in appearance by rolling between palms
- Can combine with rapid or short acting insulin in a single syringe

American Diabetes Association. (2015)

Long-Acting Insulin

Long acting
Detemir (*Levemir®*)
Glargine (*Lantus®*)
Glargine U-300 (*Toujeo®*)
Degludec (Tresiba®)

Properties	
Onset	3-6 hours
Peak	none
Duration	approx. 24hrs

https://www.lantus.com/get-to-know-the-lantus-solostar-pen

https://www.levemir.com/

Clinical Pearls

- Cannot combine in syringe with other insulin
- Usually QD or BID
- Do not omit when NPO
- Consider decreasing dose when NPO

American Diabetes Association. (2015)

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Glargine 300U (Toujeo®)

	Glargine U100	Glargine U300
Onset	3-4 hrs	3-6 hrs
Peak	5 hrs (“none”)	12-16 hrs
Duration of action	11-24+ hrs	24+ hrs
Surface Area	100%	50%
Volume	100%	33%
Dose capacity	300 units/3 mL	450 units/1.5 mL
Max single dose	80 units	160 units

American Diabetes Association. (2015)

Degludec (Tresiba®)

	Degludec U100	Degludec U200
Onset	1 hr	1 hr
Peak	9 hrs	9 hrs
Duration of action	42+ hrs	42+ hrs
Surface Area	50%	50%
Volume	33%	33%
Dose capacity	300 units/3 mL	600 units/3 mL
Max single dose	80 units	160 units

American Diabetes Association. (2015)

Degludec U200 (Tresiba® U200)

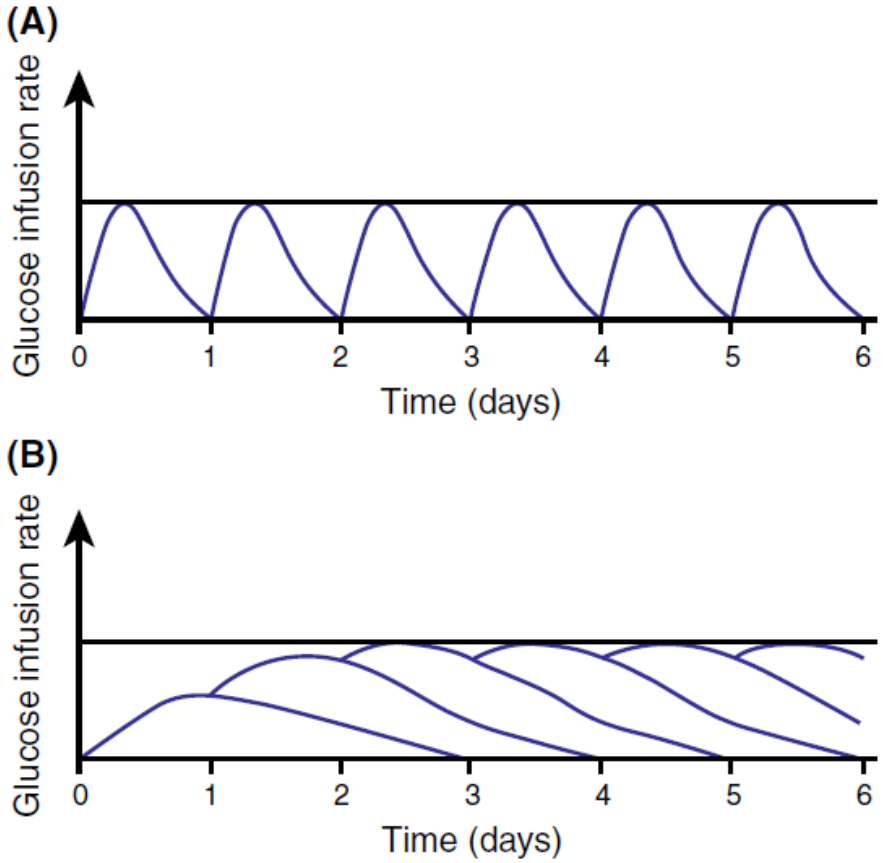


Fig. 1 Conceptual model demonstrating action profiles with once-daily dosing of a basal insulin with duration of action **a** ≤24 h and **b** substantially longer than 24 h [14]

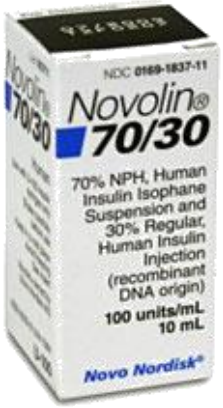
https://link.springer.com/article/10.1007/s40262-014-0165-y

American Diabetes Association. (2015)

Insulin Classes

Pre-mixed

- *Novolog 70/30®*
- *Novolin 70/30®*
- *Humalog 75/25®*
- *Humalog 50/50®*
- *Humulin 70/30®*
- *Ryzodeg 70/30®*)



http://www.foracare.com/Diabetes-Medication.html

Combination Insulins

https://www.novolin70-30.com/

http://www.foracare.com/Diabetes-Medication.html

NovoLog 70/30	Intermediate	Rapid
Novolin 70/30	Intermediate	Short
Humalog 75/25	Intermediate	Rapid
Humalog 50/50	Intermediate	Rapid
Humulin 70/30	Intermediate	Short
Ryzodeg 70/30	Long	Short

American Diabetes Association. (2015)

U-500 Regular Insulin

Clinical Pearls

- For patients with severe insulin resistance
- Vial has different shape
- Longer duration than U-100 Regular
- KwikPen less confusing

U-500 Regular

- Regular (*Humulin R®*)

http://www.foracare.com/Diabetes-Medication.html

Properties	
Onset	15-30 minutes
Peak	4-8 hours
Duration	13-24 hours

American Diabetes Association. (2015)

U-500 Regular Insulin

Dosing Table for U-500 Insulin		
Humulin R U-500 dose (units)	U-100 Insulin Syringe (unit markings)	Tuberculin Syringe (volume in mL)
20	4	0.04
50	10	0.1
75	15	0.15
* 100	*20	0.2
150	30	0.3
200	40	0.4
250	50	0.5
500	100	1.0

http://www.foracare.com/Diabetes-Medication.html

* Rx Order: "Regular insulin U-500, inject 100 units (20 units in U100 syringe) subcutaneously three times daily before meals."

American Diabetes Association. (2015)

Which of the Following is True?

A. Aspart (Novolog ®) is the most common insulin used intravenously
B. Aspart (Novolog ®) should be given 5-10 minutes prior to mealtime
C. 50 units of Regular U500 insulin is equivalent to 250 units of Regular U100 insulin
D. Degludec (Tresiba®) has same PK/PD as glargine U100

Initiating Insulin: Barriers

Barrier	Possible Discussion Points
The injection hurts.	Usually hurts less than testing blood glucose.
My life will be more complicated.	Specific complication that concerns patient. Insulin may actually add flexibility (meal timing/planning, etc.)
It means my diabetes is getting worse.	Diabetes is a progressive disease. Insulin can control BG levels and reduce risk of complications.
It means I have failed to follow my treatment regimen.	No matter how closely the DM regimen is followed, insulin may be needed since diabetes is progressive.
I will have low blood sugar reactions.	How to avoid, recognize and treat hypoglycemia.
It will decrease my quality of life.	Benefits of insulin are observed quickly: increased energy, better sleep, feeling better, etc.
I will develop complications.	Insulin may actually reduce risk of complications.
People will treat me differently.	Strategies for coping with specific people or situations.
Insulin will not help my diabetes.	Effectiveness of insulin in controlling BG levels and associated benefits.

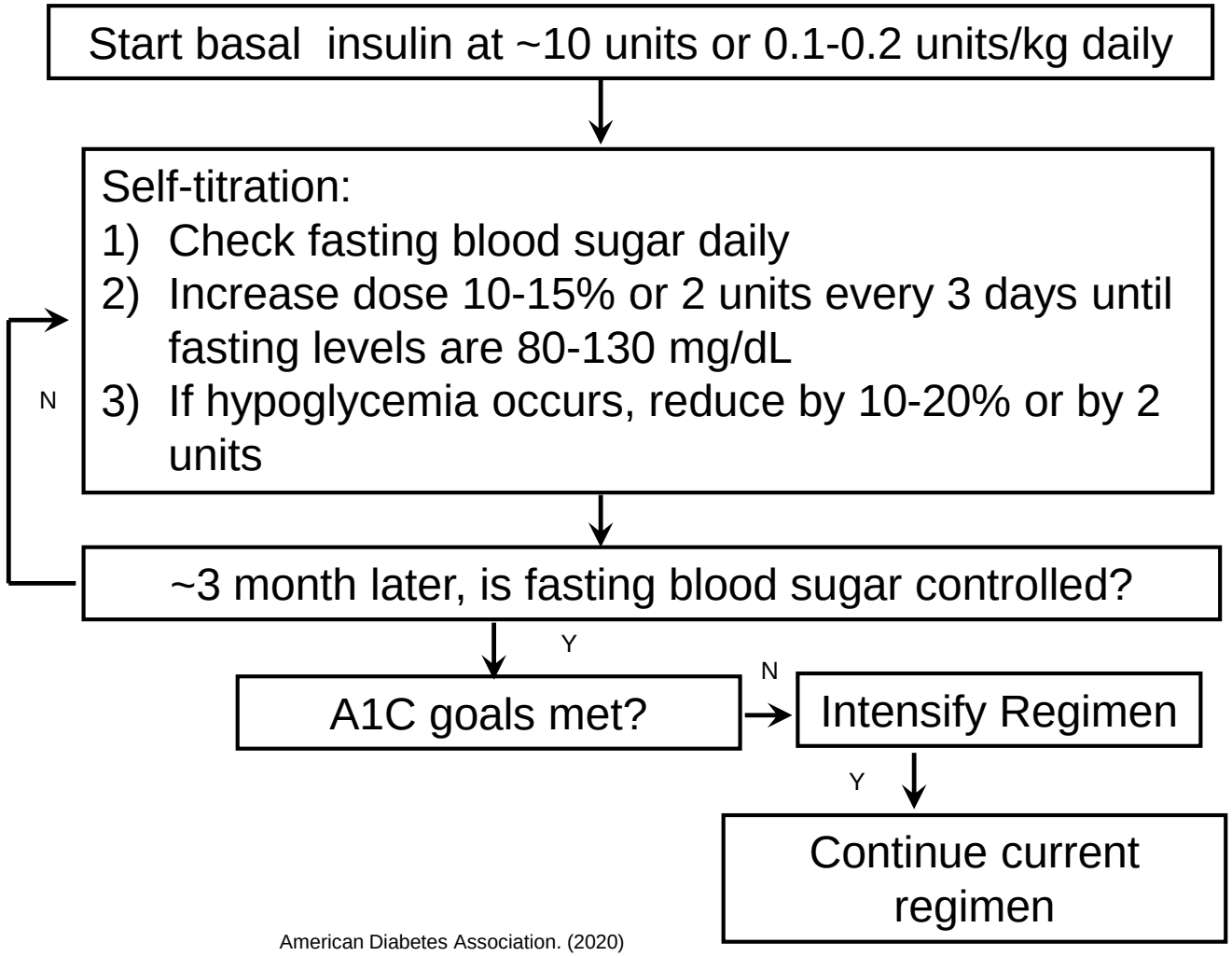
Brunton et.al. (2005)

Initiating Insulin: Barriers

Insulin	Cost to Joint Base San Antonio
*Aspart**	$1.69/ml vial and pen
Lispro	$4.55/ml vial; $3.63/ml pen
*Regular (Novolin R)**	$0.45/ml vial; $5.87/ml pen
*Regular (Novolin N)**	$0.45/ml vial; $6.01/ml pen
*Glargine (U-100)**	$1.81/ml vial and pen
Determir (U-100)	$14.37/ml vial; $15.26/ml pen
Glargine (U-300)	$18.00/ml; comes in 1.5ml pen
Degludec (U-100); (U-200)	$17.09/ml; $34.12/ml
70/30 (Novolog Mix)	$2.15/ml vial and pen
70/30 (Novolin Mix)	$0.45/ml vial; $23.56/ml pen
Regular (U-500)	$56.95/ml pen; vial unknown

Brunton et.al. (2005)

Starting Basal Insulin



American Diabetes Association. (2020)

Case Study - GD, cont'd

Adjusting your Basal (Lantus®) Insulin

Starting Dose of Lantus Insulin: 10 units at 2100 (time)

The target blood sugar for before breakfast (fasting) is 80 to 120 mg/dL. If your blood sugar is not typically in this range in the morning, you may need more or less basal insulin. Follow these steps to adjust your Lantus®:

1. Check your fasting blood sugar every day before breakfast.
2. If your fasting blood sugar is greater than 120 mg/dl for 3 days in a row, increase your daily dose of Lantus® by 2 units.
3. If your fasting morning blood sugar is less than 80 mg/dl for 2 days in a row, decrease your daily dose of Lantus® insulin by 2 units.
4. On your adjusted dose of Lantus®, continue to monitor your fasting morning blood sugar. Continue to adjust the Lantus® up or down as needed until your morning blood sugars are consistently between 80 and 120 mg/dl.
5. If you experience unexplained low blood sugar values (less than 70 mg/dL) at *any* time of the day, DO NOT increase your dose of Lantus® insulin for that day.

DCOE Patient Handout

Notes:

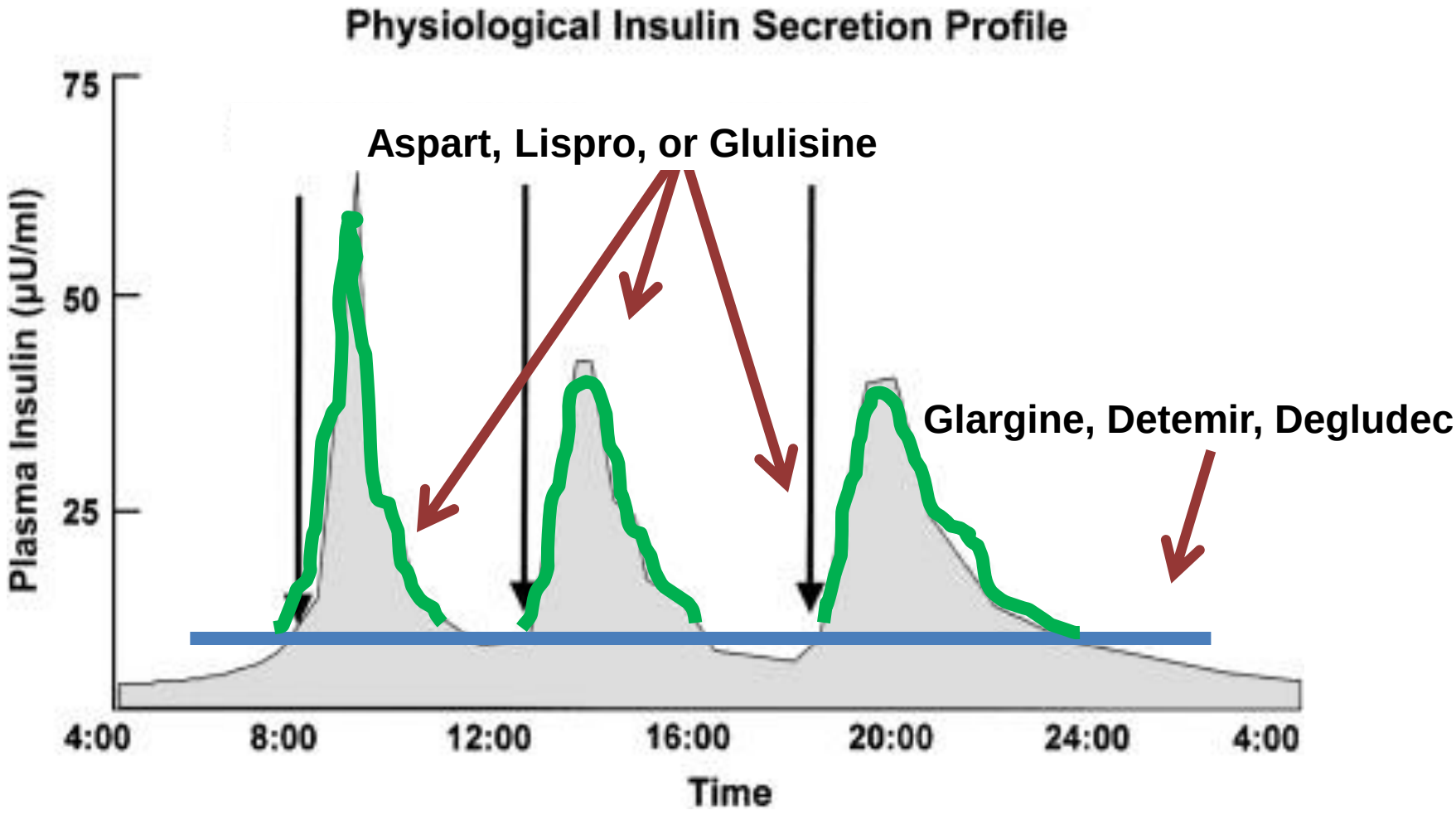
Teaching points:

- Do not skip basal dose, even if not eating
- Do not adjust dose at time of injection

Discontinue Basal Titration

- Instruct patient to STOP upward titration for:
  - Unexplained hypoglycemia
  - Reach fasting glucose goal
  - Reach total basal insulin dose of 0.5 units/kg (40-45 units in most adults with T2DM)
- Consider moving bedtime insulin to morning for nocturnal hypoglycemia

Initiating Basal/Bolus Insulin



White, R. (2007).

When to Initiate Bolus Insulin

- HbA1c above target despite titrating basal insulin to goal fasting glucose
- Total daily insulin dose is > 0.5 u/kg
- Postprandial blood sugar readings are consistently above 180mg/dl

American Diabetes Association. (2020)

Initiate Mealtime Insulin

Add 1 rapid acting insulin injection before the largest meal of the day

↓

Start: 4 units, 0.1 U/Kg, or 10% of basal dose.
If A1C is <8% consider lower basal by the same amount.

↓

Adjust: increase dose by 1-2 units or 10-15% every 3 days until reaching glucose target.

↓

Consider lowering dose by 2-4 units or 10-20% for unexplained hypoglycemia.

↓

If A1C is not at goal than advance to “basal/bolus insulin.”
Add ≥ 2 rapid-acting insulin injections before meals.

American Diabetes Association. (2020)

Titrate Mealtime Insulin

If pre-lunch blood sugar is elevated, add/increase rapid-acting insulin at **BREAKFAST**

If pre-dinner blood sugar is elevated, add/increase rapid-acting insulin at **LUNCH**

If bedtime blood sugar is elevated, add/increase rapid-acting insulin at **DINNER**

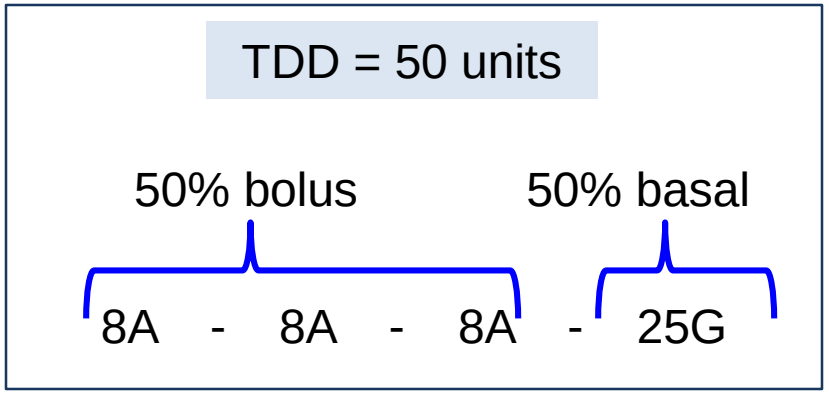
If A1C is not at goal, check 2h post-meal BG and adjust pre-meal insulin

Adapted from American Diabetes Association / European Association for the Study of Diabetes Consensus Algorithm, Jan 2009

Mealtime Insulin Example 1

- Current insulin regimen is glargine 50 units HS
- BG averages are 110, 154, 208, and 195mg/dl prior to breakfast, lunch, dinner and bedtime, respectively
- A1C is 8.3%
- Initiate mealtime insulin

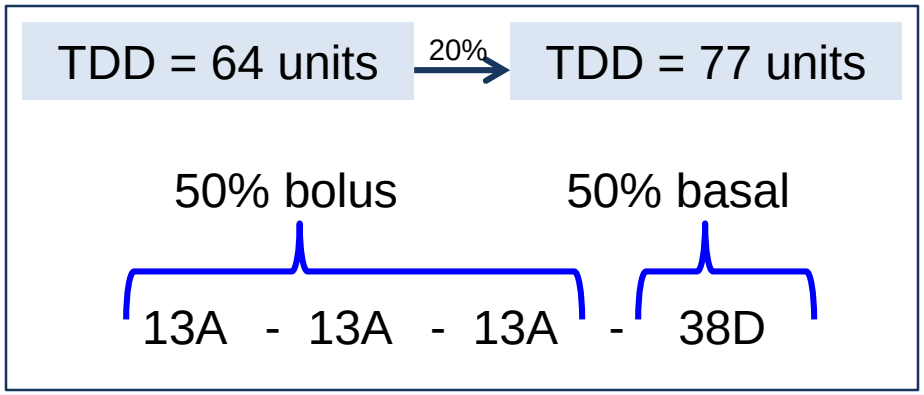
Example 1 →



Mealtime Insulin Example 2

- Current diabetes regiment is Detemir 32 units bid, metformin, and Glipizide
- BG averages are (B)206 – (L)174 – (D)192 – (HS)148
- HbA1C is 8.8%
- Discontinue Glipizide and add 10-20% insulin to TDD
- Initiate mealtime insulin

Example 2 →



Mealtime Insulin – Counting CHO

- Dose bolus insulin on carbohydrate count to be more accurate than fixed dose insulin
- Insulin/Carb ratio (IC) = carbohydrate grams that 1 unit of insulin will cover
- To estimate IC
  1) Calculate TDD of insulin
  2) IC ratio = 450-500 / TDD

Carb Counting Example

- Patient has significant meal variability in carb intake
- Patient takes 4 units of insulin aspart (NovoLog) before meals and 13 units of glargine (Lantus) at bedtime
- Total Daily Dose (TDD) = 25 units
- Insulin to Carb ratio = 500 / 25 =► 20 (1 unit insulin : 20 CHO)
- Breakfast (60 gms CHO) →

  Give only 3 units aspart insulin

  60/20 = 3.0
- Lunch (90 gms CHO) →

  Give 4 units aspart insulin [round down]

  90/20 = 4.5

Average American diet is usually >250 gm CHO daily

Correctional Insulin

- Insulin sensitivity factor = how much 1 unit of insulin should drop serum glucose drop (in mg/dL)
- To estimate sensitivity factor
  - Calculate TDD of insulin
  - Insulin sensitivity factor = 1500-1950 / TDD
- Build your correctional (sliding) scale based on insulin sensitivity

Initiating Insulin: Basal Bolus

Adjusting your Mealtime (NovoLog®) Insulin

Starting Dose of NovoLog® Insulin:

Date:

Glargine 30 units at bedtime

10 units before breakfast

10 units before lunch

10 units before dinner

Check your blood sugar before each meal and before you take your insulin. If your blood glucose is high before you eat, you may need to add extra NovoLog® to your pre-meal dose. Use the chart below to find the correct amount:

Pre-meal blood sugar	Action
Less than 70 mg/dl	Eat or drink 15 gm of carbohydrates (½ cup fruit juice or regular soda, 1 cup skim milk, or 3 glucose tablets)
70-150 mg/dl	Take normal dose (do *not* inject extra units)
151-200 mg/dL	Add 2 extra unit(s)
201-250 mg/dL	Add 4 extra unit(s)
251-300 mg/dL	Add 6 extra unit(s)
301-350 mg/dL	Add 8 extra unit(s)
351-400 mg/dL	Add 10 extra unit(s)

* Important: If you find that you usually have to add insulin to your pre-meal dose, discuss this with your provider; your dosages may need to be reviewed and adjusted.

DCOE Patient Handout

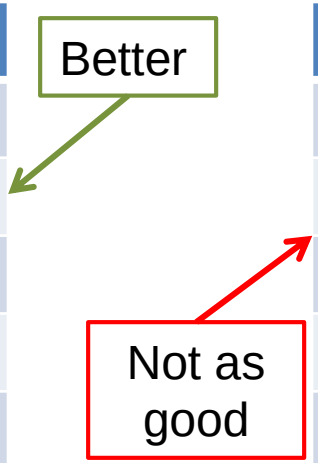
Patient teaching:

- Do not take meal insulin if not eating
- Should not take insulin more than 15 minutes before eating
- Mealtime doses based on regular size meal, not small snack
- If not eating AND BG is high, correction insulin is okay by itself but not more frequent than Q4H

Correctional Insulin Example

- Patient takes 8 units of insulin aspart (NovoLog) before meals and 25 units of detemir (Levemir) at bedtime
- TDD = 49 units ~ 50 units
- Insulin Sensitivity Factor = 1500 / 50 =► 30

FS	Additional Mealtime Insulin	Total
150-180	1 unit	9 units
181-210	2 units	10 units
211-240	3 units	11 units
241-270	4 units	12 units
271-300	5 units	13 units

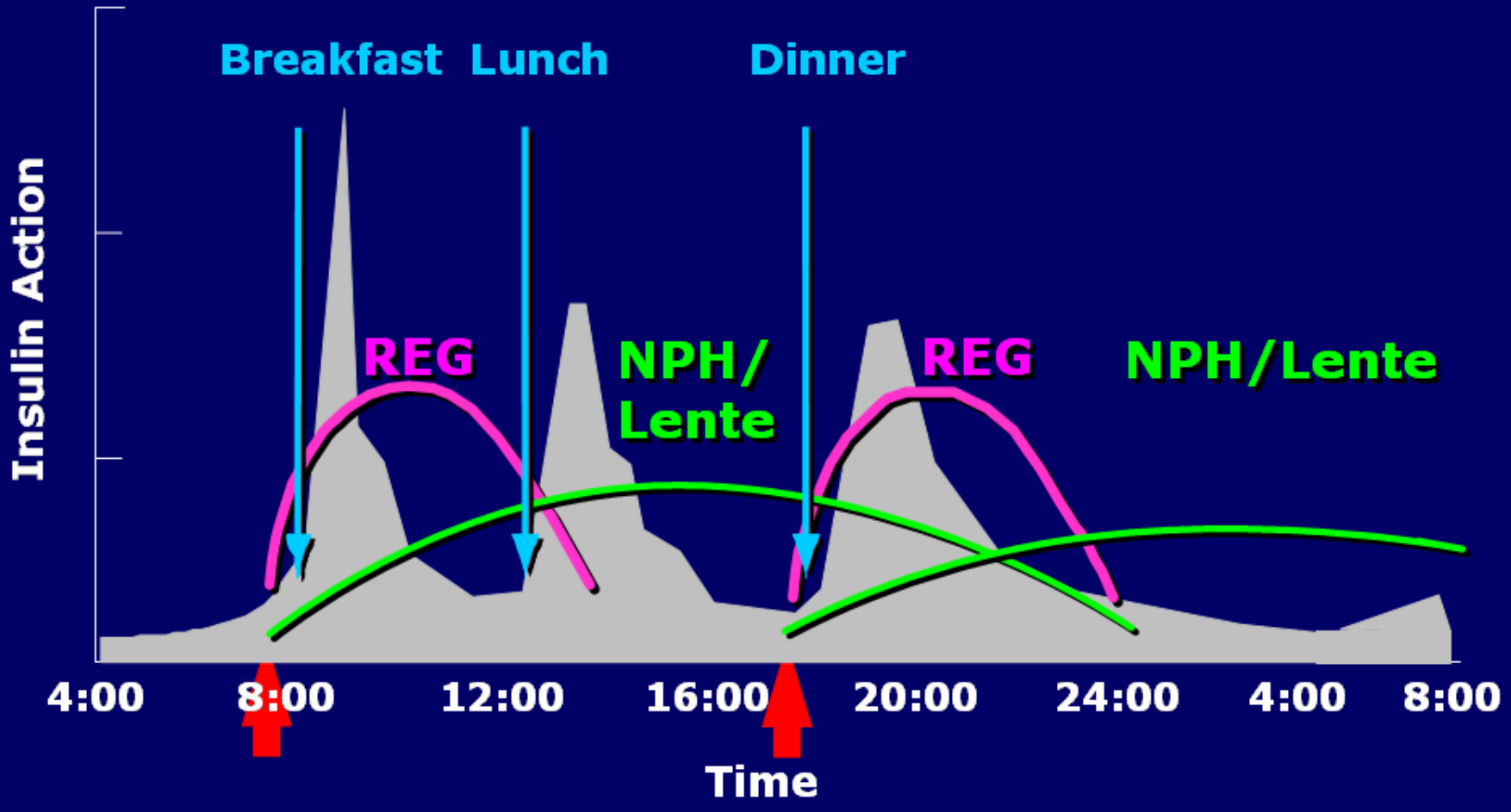


Pre-Mixed Insulin

- Pros
  - Lowers A1C better than basal insulin alone
  - Covers basal and prandial needs with fewer injections
  - Fewer injections may increase adherence
  - Good choice for pts who need assistance from a caregiver
  - Cheaper
- Cons
  - Patients cannot self-titrate basal or correct with rapid-acting
  - Increased risk for hypoglycemia and weight gain
  - More difficult to address a single trouble area of BG

American Diabetes Association. (2015)

Twice-Daily Split-Mixed Regimen or 70/30 Conventional Insulins



1. Adapted with permission from Leahy J. In: Leahy J, Cefalu W, eds. *Insulin Therapy*. New York: Marcel Dekker; 2002:87-112. **2.** Nathan DM. *N Engl J Med*. 2002;347:1342-1349.

Initiate Premixed Insulin

On basal insulin. Patient prefers premixed twice daily to basal plus one rapid acting insulin injection before the largest meal of the day

↓

Start: Divide current basal dose to give 2/3 before breakfast and 1/3 before dinner. Can alternatively give ½ before breakfast and ½ before dinner.

↓

Adjust: Increase dose by 1-2 units or 10-15% every 3 days until reaching glucose target.

↓

Consider lowering dose by 2-4 units or 10-20% for hypoglycemia.

↓

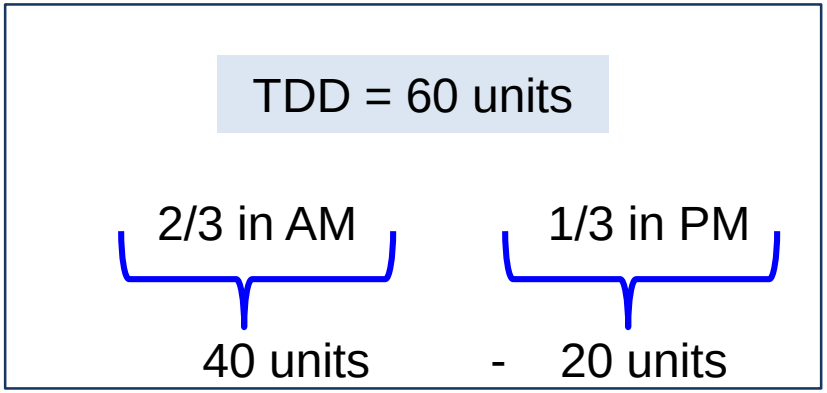
If A1C is not at goal, could consider premixed TID

Giugliano *et al* (2016).

Pre-Mixed Insulin Example

- Patient is taking glargine 30 units HS and aspart 10 units AC
- BG averages are (B)114 – (L)157 – (D)208 – (HS)131
- HGB A1C is 8.1% (individual goal is 7 – 7.5%)
- TDD = 10A + 10A + 10A + 30G = 60 units
- Convert to Premix insulin

Example →



BREAK

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1530 - 1630
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Presenters

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Objectives

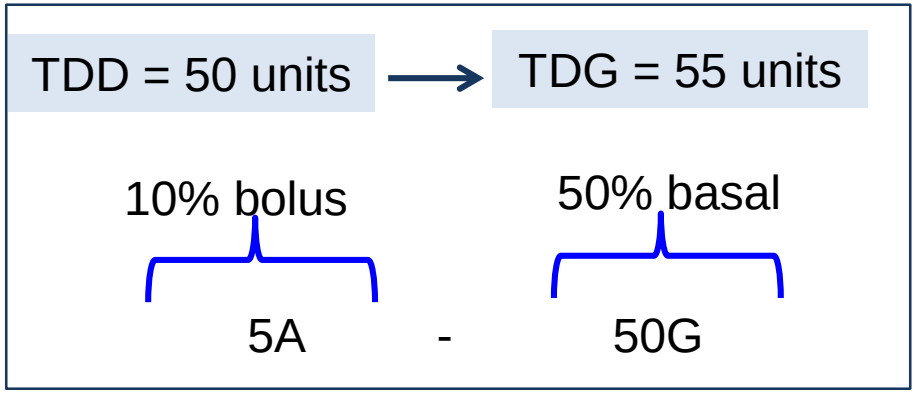
Participant will be able to:

- Compare strategies for initiating insulin
- Outline titration/dosing of insulin
- Demonstrate recognition of blood glucose patterns that could influence insulin dosing

Case 1

- Current insulin regimen is glargine 50 units HS
- BG averages are 110, 154, 208, and 195mg/dl prior to breakfast, lunch, dinner and bedtime, respectively
- A1C is 8.3%
- Initiate mealtime insulin

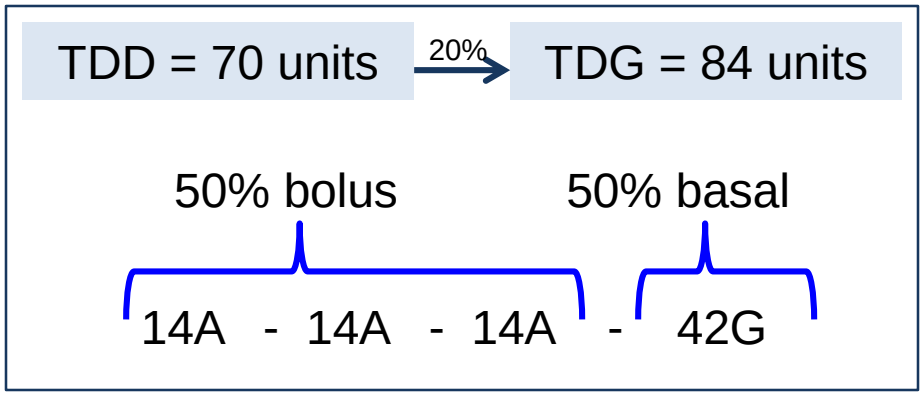
Example 1 →



Case 2

- Current diabetes regiment is glargine 64 units daily and Novolog 6 units with dinner. He has not had hypoglycemia
- BG averages are (B)109 – (L)248 – (D)301 – (HS)148
- HbA1C is 8.8%
- Add 10-20% insulin to TDD
- Add additional mealtime insulin

Example 2 →



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Case 3

- 45 year old patient with DM2 on metformin 1000mg BID, sitagliptin 100mg daily, glimepiride 4mg daily and pioglitizone 15mg daily. Patient has attempted exenatide but stopped due to significant nausea and vomiting
- Pioglitizone (Actos) 15mg was added 6 months ago after long discussion and the patient's desire not to start insulin
- Pt did agree to checking blood glucose 4 times a day for two weeks prior to the next visit
- 3 months ago the patient got her labs done but did not show up to clinic (called and said she didn't check her blood sugars and said the appointment would be USELESS) – then went out of town for 3 months
- A1c: 9.5% (6 months ago), 8.7% (3 months ago), 8.5% (today)

Case 3

BG Goals: AM Fasting 80-120, 2hr post meal <180 mg/dl, preprandial <140 mg/dl

- Pt now presents on the above regimen with an A1c of **8.5%**
- Pt has been concerned about her disease and started tracking her blood sugars

Date	Breakfast	Lunch	Dinner	Bedtime
8-May	170	144	159	220
7-May	161	170		172
6-May	165	264		161
5-May	177	190	188	277
4-May	155	130	220	
3-May	141	208	158	247
2-May	176		85	221
1-May	174	137		239
30-Apr	194	237	125	84
29-Apr	191	204	207	
28-Apr	150	169	176	
27-Apr	237			
Average	174	185	165	203

Case 3

BG Goals: AM Fasting 80-120, 2hr post meal <180 mg/dl, preprandial <140 mg/dl

- 1 month later:

Glargine – 28 units HS

Date	Breakfast	Lunch	Dinner	Bedtime	▲
7 June	119	170	132	148	
6- June	115	264	167	161	
5-June	129	90	88	77	
4-June	125	130	108	130	
3-June	118	208	158	247	
2-June	121	94	85	121	
1-June	131	137	147	139	+2
31-May	125	236	125	104	
30-May	130	204	207	92	
29 – May	110	169	106	128	
28 – May	145	162	81	71	
27 – May	150	140	124	205	+2
26 – May	146	108	116	134	
26 – May	155	140	124	205	

Case 3

BG Goals: AM Fasting 80-120, 2hr post meal <180 mg/dl, preprandial <140 mg/dl

- **2 months** (3 mo from baseline)

Glargine – 32 units HS

- Pt titrated her glargine dose to 32 units every night
- A1C now 6.9%

Date	Breakfast	Lunch	Dinner	Bedtime	▲
8-Aug	110	144	159	120	
7-Aug	110	170	72	172	
6- Aug	115	160	167	161	
5-Aug	130	90	88	77	
4-Aug	114	130	108	130	
3-Aug	105	208	158	147	
2-Aug	115	94	105	121	
1-Aug	110	137	147	139	
31-July	112	150	125	84	
30-July	75	204	187	122	-2
29 – July	79	200	191	118	
28 – July	118	162	81	71	
27 – July	95	140	124	190	
26 – July	111	98	136	114	
25 – July	110	140	124	165	

Case 3 (2 yrs Later)

BG Goals: AM Fasting 80-120, 2hr post meal <180 mg/dl, preprandial <140 mg/dl

- AM fasting sugars are at goal
- Premeal BG values elevated
- HbA1C is elevated
- Patient states she is willing to consider pre-meal insulin

Glargine – 50 units HS

Date	Breakfast	Lunch	Dinner	Bedtime
18-Apr	123	205	201	220
17-Apr	115	170	175	172
16-Apr	147	264	167	161
15-Apr	110	190	190	256
14-Apr	117	153	180	233
13-Apr	134	208	158	247
12-Apr	111	94	185	221
11-Apr	105	137	147	249
10-Apr	139	237	125	184
9-Apr	112	204	207	192
8-Apr	101	169	250	210
7-Apr	118	162	191	215
Average	119	183	181	213

Case 3 (2 yrs Later)

BG Goals: AM Fasting 80-120, 2hr post meal <180 mg/dl, preprandial <140 mg/dl

- **1 month post bolus start:**

Glargine – 38 units HS; Novolog 10 units AC

- Titrated basal insulin up to 38 units
- States she eats all day when she has low BG
- What adjustments are need?

Date	Breakfast	Lunch	Dinner	Bedtime	▲
29-May	110	83	159	145	
28-May	108	75	152	197	
27- May	115	80	167	186	
26-May	130	94	88	102	
25-May	125	100	108	155	
24-May	118	95	158	200	
23-May	121	62	250	235	
22-May	131	137	147	164	+2
21-May	125	89	125	153	
20-May	132	104	151	137	
19 – May	109	74	195	231	
18 – May	125	131	142	142	
17 – May	187	85	124	200	+2
16 – May	146	79	195	293	
15 – May	145	95	124	205	

Case 3 (5 yrs Later)

BG Goals: AM Fasting 80-120, 2hr post meal <180 mg/dl, preprandial <140 mg/dl

- **5 years later**
  - HbA1c 9.0%
  - Under extreme stress; being followed by mental health
  - Only taking her basal insulin (50 units QHS) for past 6 mos
  - States she "feels fine"
  - No longer willing to take four shots per day

Glargine – 50 units HS (self d/c bolus insulin)

Date	Breakfast	Lunch	Dinner	Bedtime
24-Apr	166	210	251	301
23-Apr	222		186	
22-Apr		204		189
21-Apr	174		256	
20-Apr		189		
19-Apr	191			234
18 Arp		195		
17-Apr				
16-Apr	185	186		
15-Apr	146			
14-Apr			293	231
13-Apr	235			
12-Apr		256		
11-Apr	123			
Average	180	207	247	239

Case 4

- Glargine titration
  - Increase dose if morning not within goal
  - Goal: 80-120 in AM
  - Adjustment: Increase 2 units every 3 days if glucose above 120 mg/dl

Day	Breakfast	Lunch	Dinner	HS
1	198			
2	174			
3	187			

All values above goal → increase Glargine by 2 units. Repeat testing.

Case 4

- Glargine titration complete since morning goal reached

Day	Breakfast	Lunch	Dinner	HS
1	96			
2	114			
3	105			

- Follow-up at 3 months
  - HGB A1c: 8.9%
  - eAG: 210 mg/dl

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Case 4

- Glargine titration complete

Day	Breakfast	Lunch	Dinner	HS
1	89	148	175	**230**
2	114	162	**218**	**241**
3	101	**181**	179	**204**
4	82	136	**203**	**329**

Case 5

- Insulin dose: 25G/5A – 8A – 10A – 0
- Correction: None

Day	Breakfast	Lunch	Dinner	HS
1	112	158	175	164
2	104	**172**	**181**	**204**
3	91	**201**	**222**	**210**
4	83	**186**	163	160

- Pattern:
- Cause:
- Treatment:

Case 6

- Insulin dose: 18A – 10A – 20A – 55G

TDD 103 units

- Correction: None

Day	Breakfast	Lunch	Dinner	HS
1	201	148	122	106
2	190	177	155	124
3	191	149	112	132
4	173	164	136	97

- Pattern:
- Cause:
- Treatment:

Case 7

- Glargine 34 units HS
- Aspart 3 units per 50 above 150 mg/dl

Day	Breakfast	Post-Breakfast	Lunch	Post-Lunch	Dinner	HS
1	87 (0u)		185 (3u)			201 (0u)
2		244 (6u)	45		312 (12u)	72
3	133				196 (3u)	
4			177 (3u)	143		184
5		317 (12u)	62	279 (9u)	59	
6					171 (3u)	149
7	153		191 (3u)			

Case 8

- Insulin dose: 10G/3A – 4A – 4A – 0

TDD 21 units

- Correctional insulin: 1 unit per 90 above 190 mg/dl

Day	Breakfast	Post-Breakfast	Lunch	Post-Lunch	Dinner	HS
1	95	69	181	154	206 (1u)	127
2	155	89	159	69	231 (1u)	138
3	140	103	167	116	195 (1u)	152
4	87	51	248 (1u)	160	174	146
5	114	92	134	104	199 (1u)	-
6	103	45	207 (1u)	121	186 (1u)	133

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Summary

- Classes: ultra-rapid, rapid, short, intermediate and long-acting
- Start with basal insulin
- Add bolus insulin with the largest meal of the day (preferred) or change to premixed insulin
- Add additional injections with other meals
- Pre-lunch blood sugar tells you about BREAKFAST bolus
- Pre-dinner blood sugar tells you about LUNCH bolus
- Bedtime blood sugar tells you about DINNER bolus

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Questions