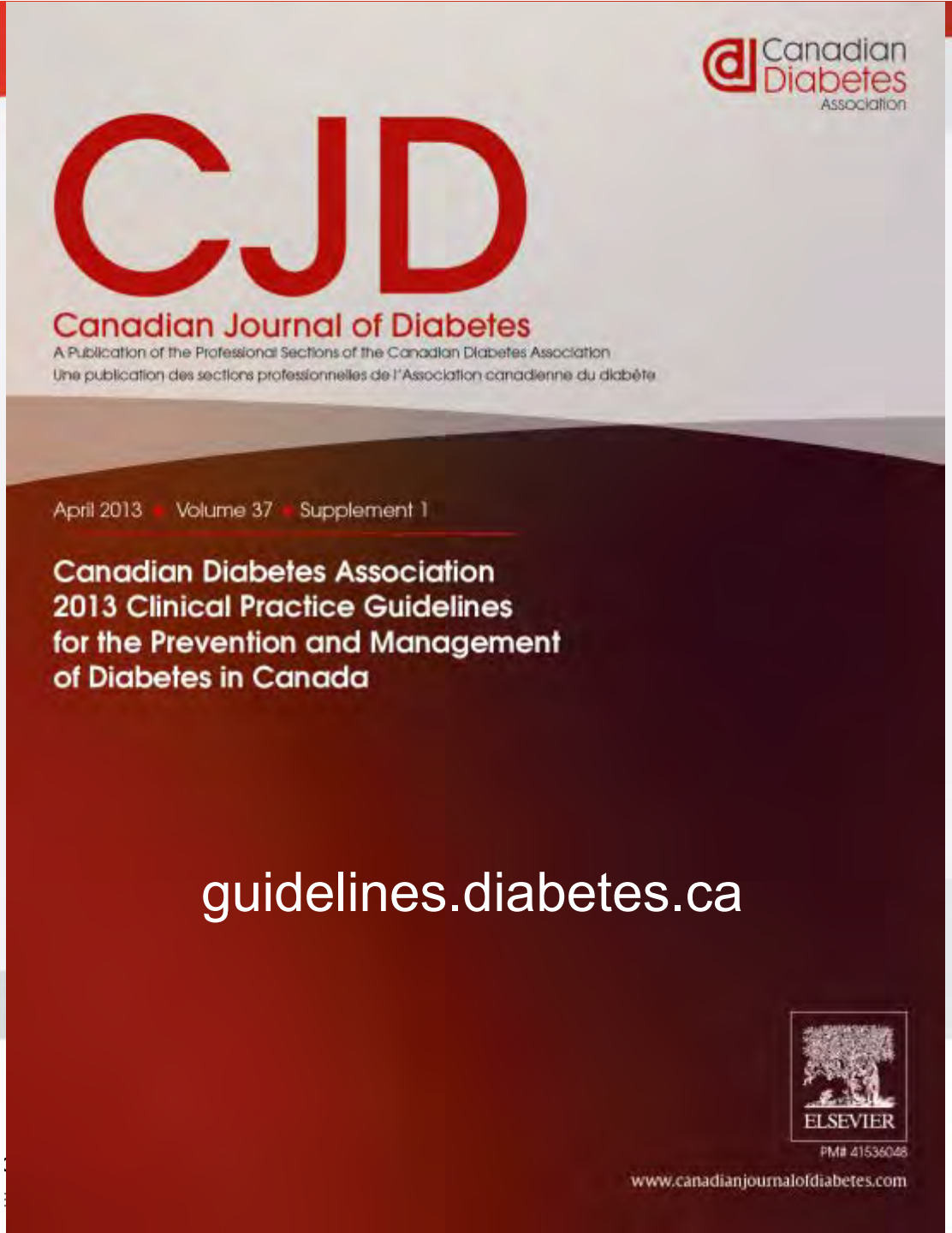
Insulin 301:
Case, after case, after case

Learning objectives

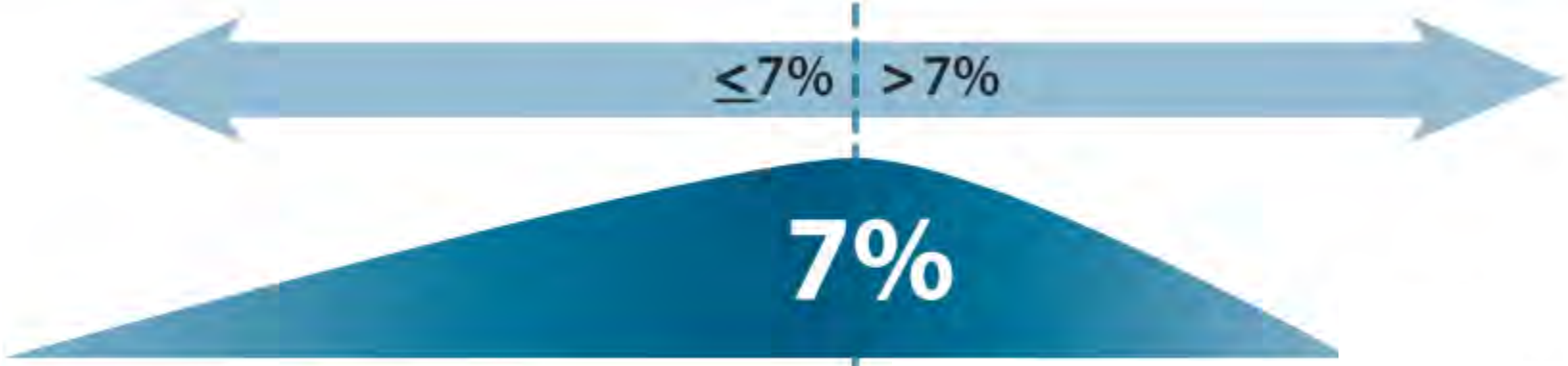
By the end of this session, you will be able to :

1. List the 3 types of insulin, 3 insulin regimens and pros/cons of each
2. Select the regimen best suited for a particular patient with dosing and titration
3. Address issues in patients on glucocorticoids, dialysis, acute infection, parenteral feeds



Canadian Diabetes Association

Individualizing A1C Targets 2013

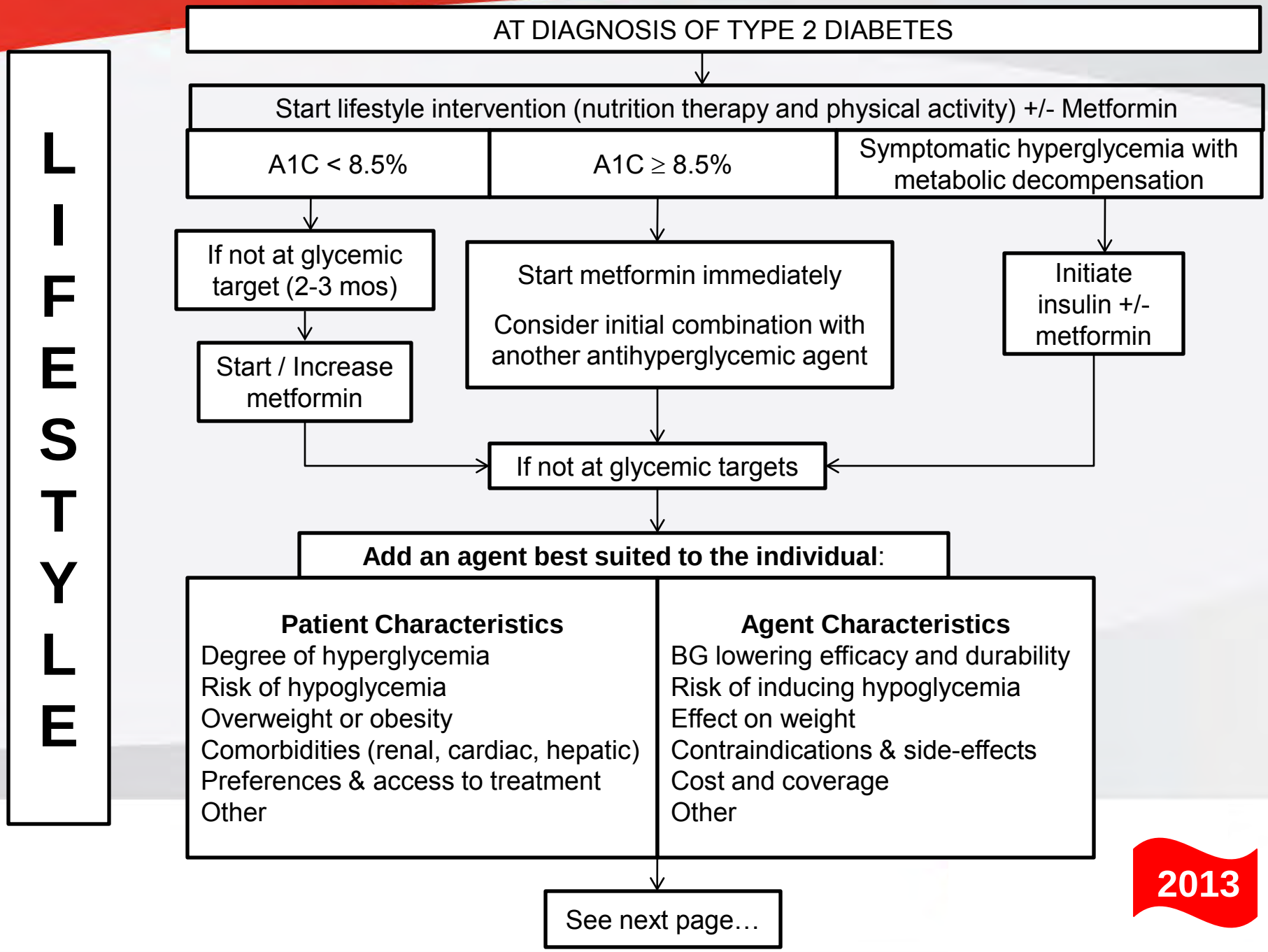


A target A1C ≤6.5% may be considered in some patients with type 2 diabetes to further lower the risk of nephropathy and retinopathy which must be balanced against the risk of hypoglycemia

Most patients with type 1 and type 2 diabetes

Consider 7.1-8.5% if:

- Limited life expectancy
- High level of functional dependency
- Extensive coronary artery disease at high risk of ischemic events
- Multiple co-morbidities
- History of recurrent severe hypoglycemia
- Hypoglycemia unawareness
- Longstanding diabetes for whom it is difficult to achieve an A1C ≤7%, despite effective doses of multiple antihyperglycemic agents, including intensified basal-bolus insulin therapy


AT DIAGNOSIS OF TYPE 2 DIABETES
Start lifestyle intervention (nutrition therapy and physical activity) +/- Metformin
A1C < 8.5%
A1C ≥ 8.5%
Symptomatic hyperglycemia with metabolic decompensation
If not at glycemic target (2-3 mos)
Start / Increase metformin
Start metformin immediately
Consider initial combination with another antihyperglycemic agent
Initiate insulin +/- metformin
If not at glycemic targets
Add an agent best suited to the individual:
Patient Characteristics
Degree of hyperglycemia
Risk of hypoglycemia
Overweight or obesity
Comorbidities (renal, cardiac, hepatic)
Preferences & access to treatment
Other
Agent Characteristics
BG lowering efficacy and durability
Risk of inducing hypoglycemia
Effect on weight
Contraindications & side-effects
Cost and coverage
Other
See next page…
LIFESTYLE
2013

From prior page...

LIFESTYLE

Add an agent best suited to the individual (agents listed in alphabetical order):

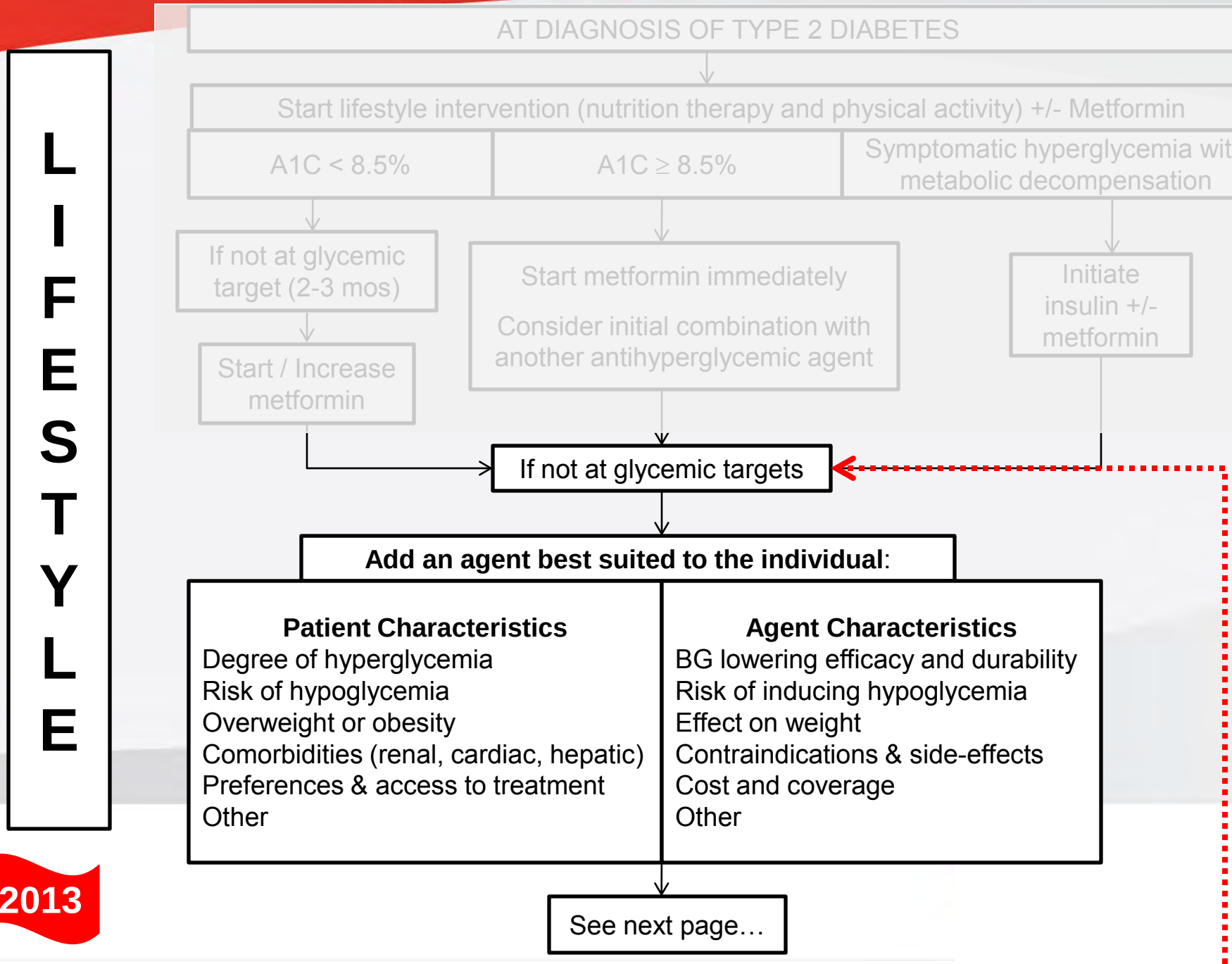
Class	Relative A1C lowering	Hypo-glycemia	Weight	Other therapeutic considerations	Cost
Alpha-glucosidase inhibitor (acarbose)	↓	Rare	neutral to ↓	Improved postprandial control, GI side-effects	$$
Incretin agents:					
DPP-4 Inhibitors	↓↓	Rare	neutral to ↓		$$$
GLP-1 receptor agonists	↓↓ to ↓↓↓	Rare	↓	GI side-effects	$$$$
Insulin	↓↓↓	Yes	↑↑	No dose ceiling, flexible regimens	$-$$$$
Insulin secretagogue:					
Meglitinide	↓↓	Yes	↑	Less hypoglycemia in context of missed meals but usually requires TID to QID dosing	$$
Sulfonylurea	↓↓	Yes	↑	Gliclazide and glimepiride associated with less hypoglycemia than glyburide	$
TZD	↓↓	Rare	↑↑	CHF, edema, fractures, rare bladder cancer (pioglitazone), cardiovascular controversy (rosiglitazone), 6-12 weeks required for maximal effect	$$
Weight loss agent (orlistat)	↓	None	↓	GI side effects	$$$

If not at glycemic target

- Add another agent from a different class
- Add/Intensify insulin regimen

Make timely adjustments to attain target A1C within 3 to 6 months

2013


LIFESTYLE
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Comorbidities (renal, cardiac, hepatic)
Preferences & access to treatment
Other
Agent Characteristics
BG lowering efficacy and durability
Risk of inducing hypoglycemia
Effect on weight
Contraindications & side-effects
Cost and coverage
Other
See next page…
2013

Add an agent best suited to the individual (agents listed in alphabetical order):					
Class	**Relative A1C lowering**	**Hypo-glycemia**	**Weight**	**Other therapeutic considerations**	**Cost**
Alpha-glucosidase inhibitor (acarbose)	↓	Rare	neutral to ↓	Improved postprandial control, GI side-effects	$$
Incretin agents: DPP-4 Inhibitors GLP-1 receptor agonists	 ↓↓ ↓↓ to ↓↓↓	 Rare Rare	 neutral to ↓ ↓	 GI side-effects	 $$$ $$$$
Insulin	↓↓↓	Yes	↑↑	No dose ceiling, flexible regimens	$-$$$$
Insulin secretagogue: Meglitinide Sulfonylurea	 ↓↓ ↓↓	 Yes Yes	 ↑ ↑	 Less hypoglycemia in context of missed meals but usually requires TID to QID dosing Gliclazide and glimepiride associated with less hypoglycemia than glyburide	 $$ $
TZD	↓↓	Rare	↑↑	CHF, edema, fractures, rare bladder cancer (pioglitazone), cardiovascular controversy (rosiglitazone), 6-12 weeks required for maximal effect	$$
Weight loss agent (orlistat)	↓	None	↓	GI side effects	$$$

Remember Insulin 101 and 201?

3 Types of insulins

BOLUS

- Regular or Toronto
- Aspart (Novorapid)
- Glulisine (Apidra)
- Lispro (Humalog)

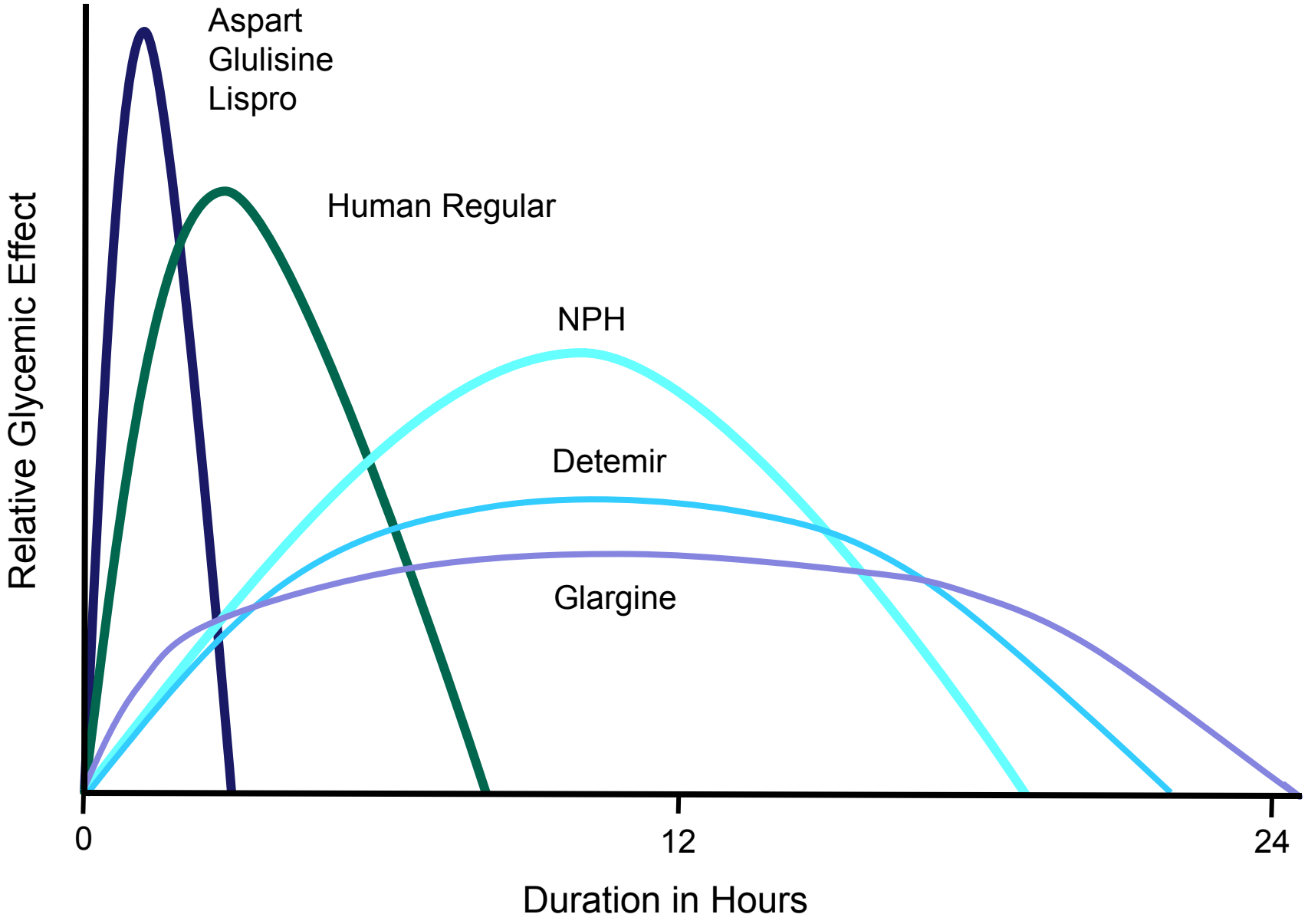
BASAL

- NPH
- Detemir (Levemir)
- Glargine (Lantus)

PRE-MIXED

- 30/70
- insulin lispro/lispro protamine (Humalog Mix25, Mix50)
- Biphasic insulin aspart (Novomix 30)

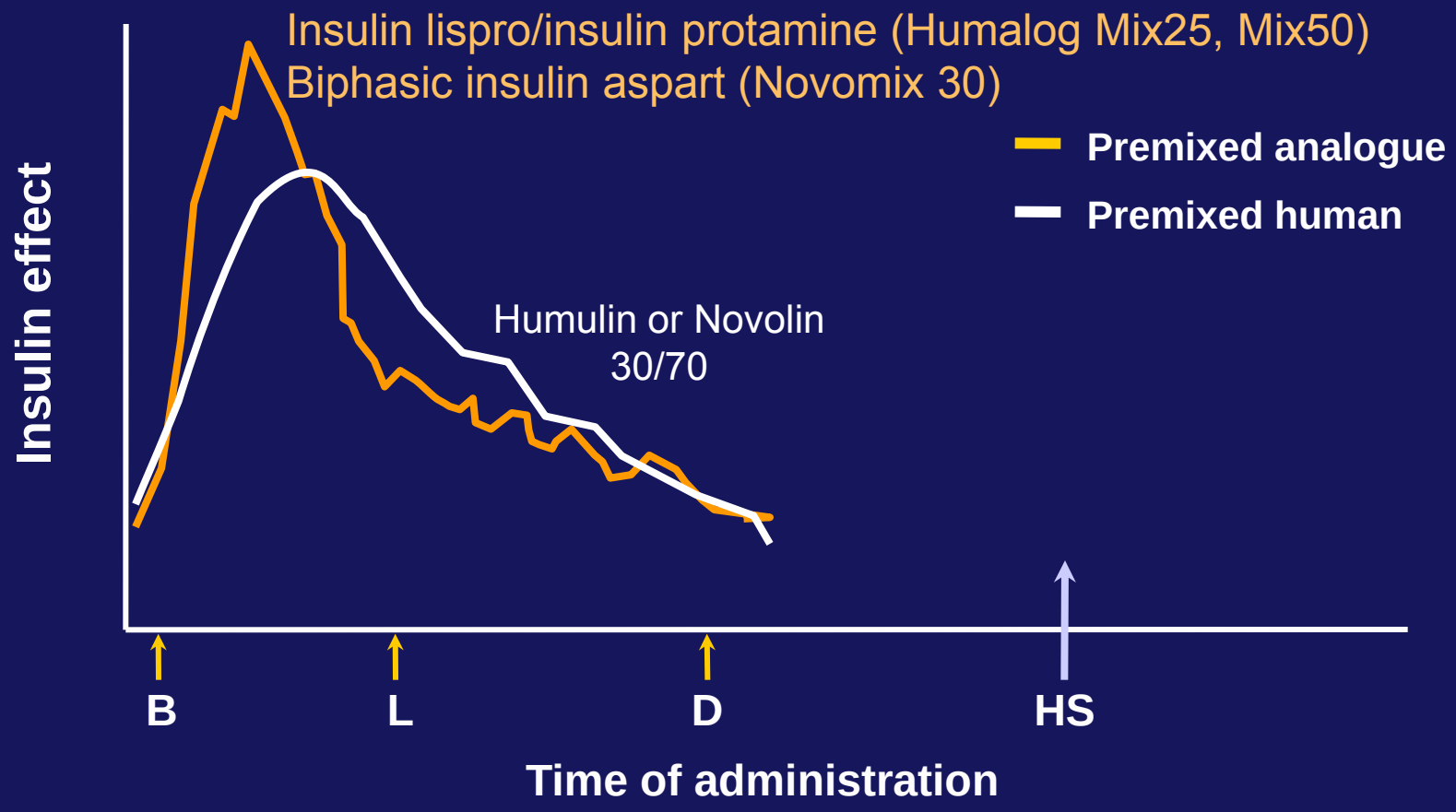
Canadian Diabetes Association Clinical Practice Guidelines. *Can J Diabetes* 2013; 37(suppl 1):S1-S212



PRE-MIXED: 30/70, Humalog Mix25, Mix50, Novomix 30

McMahon GT, Dluhy RG. NEJM 2007;357:1759.

Premixed


Insulin lispro/insulin protamine (Humalog Mix25, Mix50)
Biphasic insulin aspart (Novomix 30)
Premixed analogue
Premixed human
Humulin or Novolin 30/70
Insulin effect
B
L
D
HS
Time of administration

CDA 2013 Clinical Practice Guidelines: Pharmacologic therapy in type 2 diabetes

Recommendation #5:

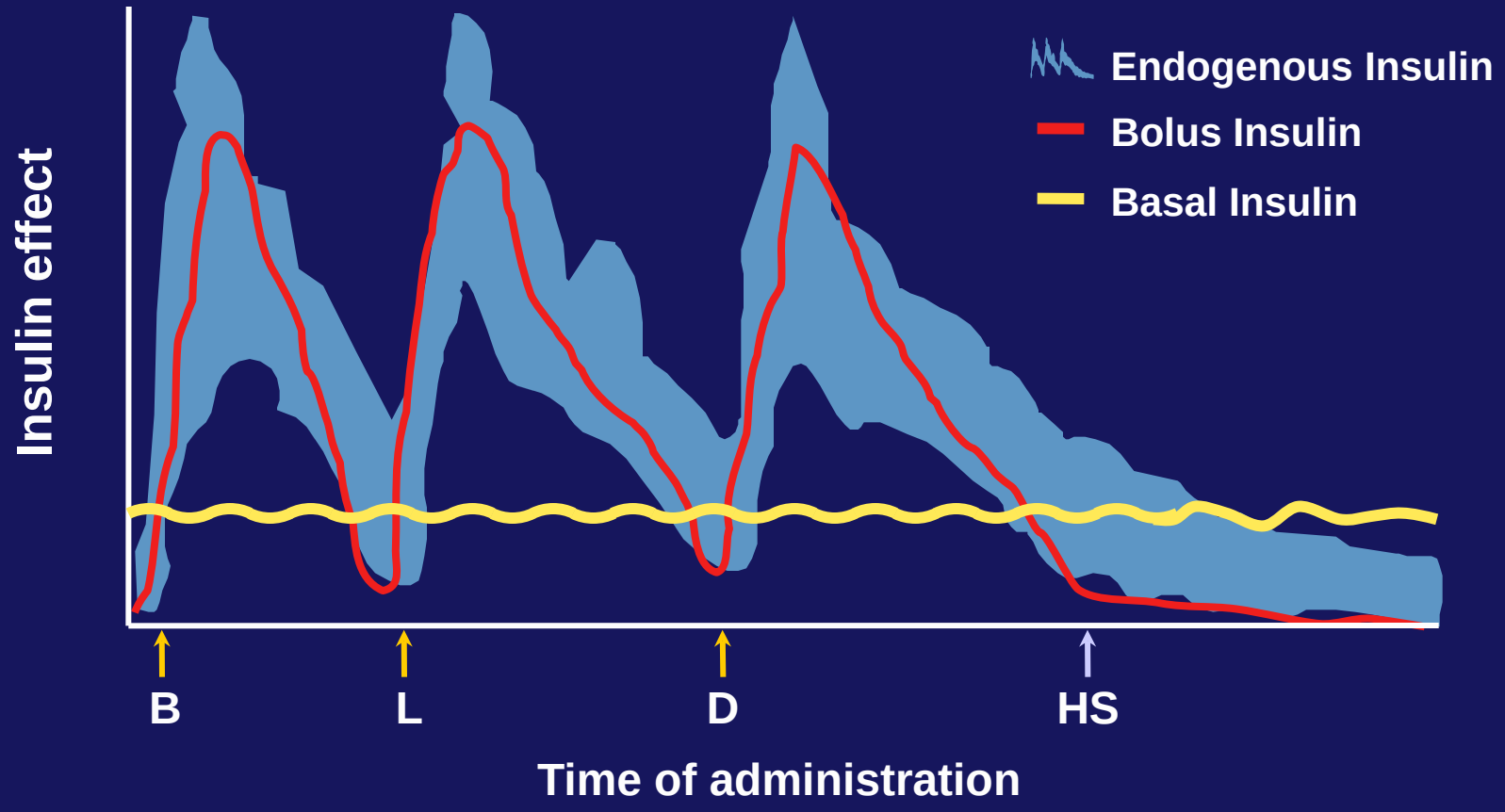
When **basal** insulin is added to antihyperglycemic agents, **long-acting analogues** (detemir or glargine) may be used instead of intermediate-acting NPH to reduce the risk of nocturnal and symptomatic hypoglycemia *[Grade A, Level 1A]*

CDA 2013 Clinical Practice Guidelines: Pharmacologic therapy in type 2 diabetes

Recommendation #6:

When **bolus** insulin is added to antihyperglycemic agents, **rapid-acting analogues** (insulin aspart, glulisine, or lispro) may be used instead of regular insulin to reduce the risk of hypoglycemia *[Grade A, Level 1A]*

Normal Insulin Secretion: The Basal-Bolus Insulin Concept

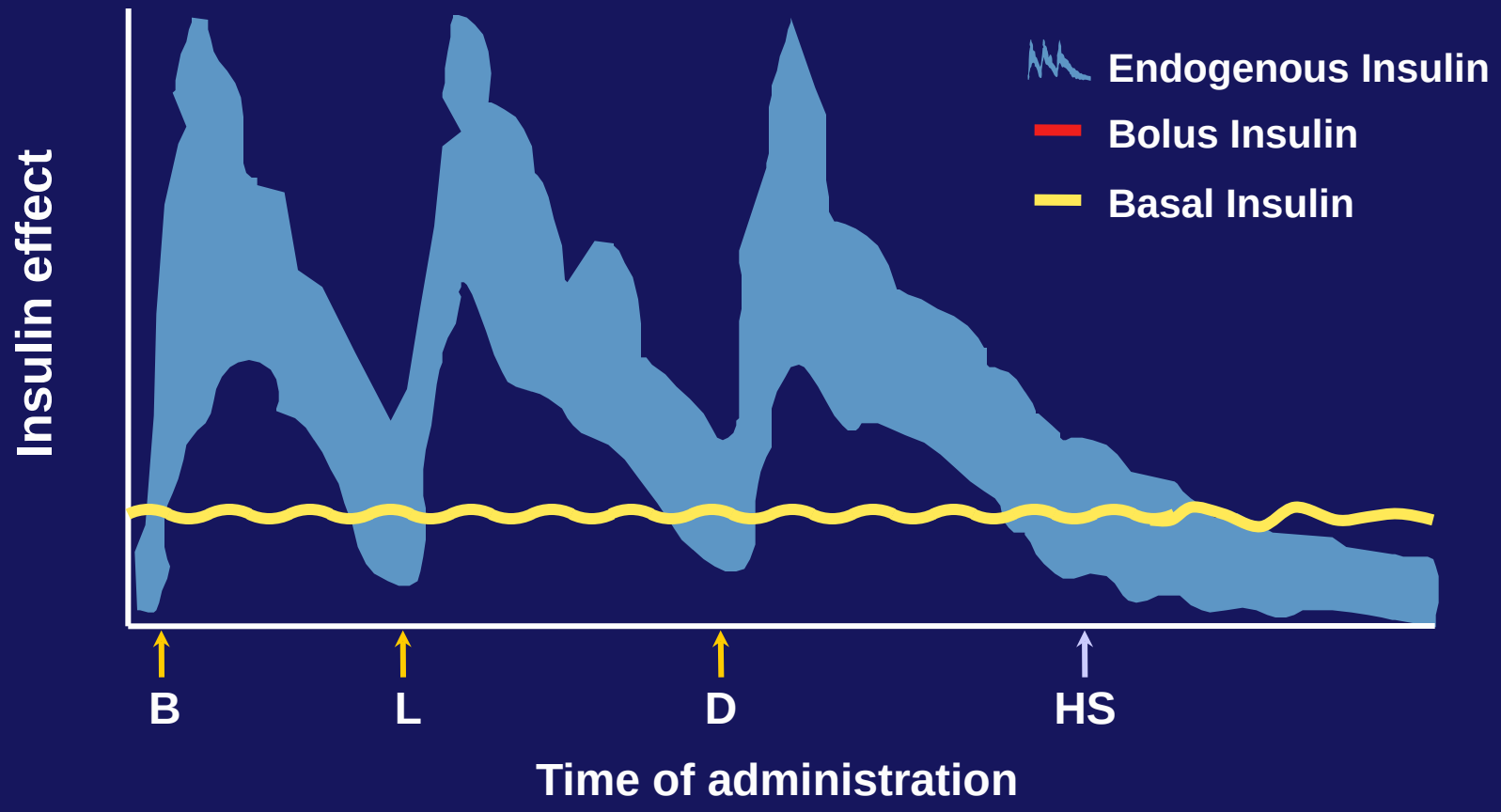


B = breakfast; L = lunch; D = dinner; HS = bedtime.

1. Leahy JL. In: Leahy JL, Cefalu WT (eds). *Insulin Therapy.* Marcel Dekker Inc., New York, 2002.
2. Bolli GB, et al. Diabetologia 1999; 42:1151-67.

3 Insulin Regimens

Basal alone



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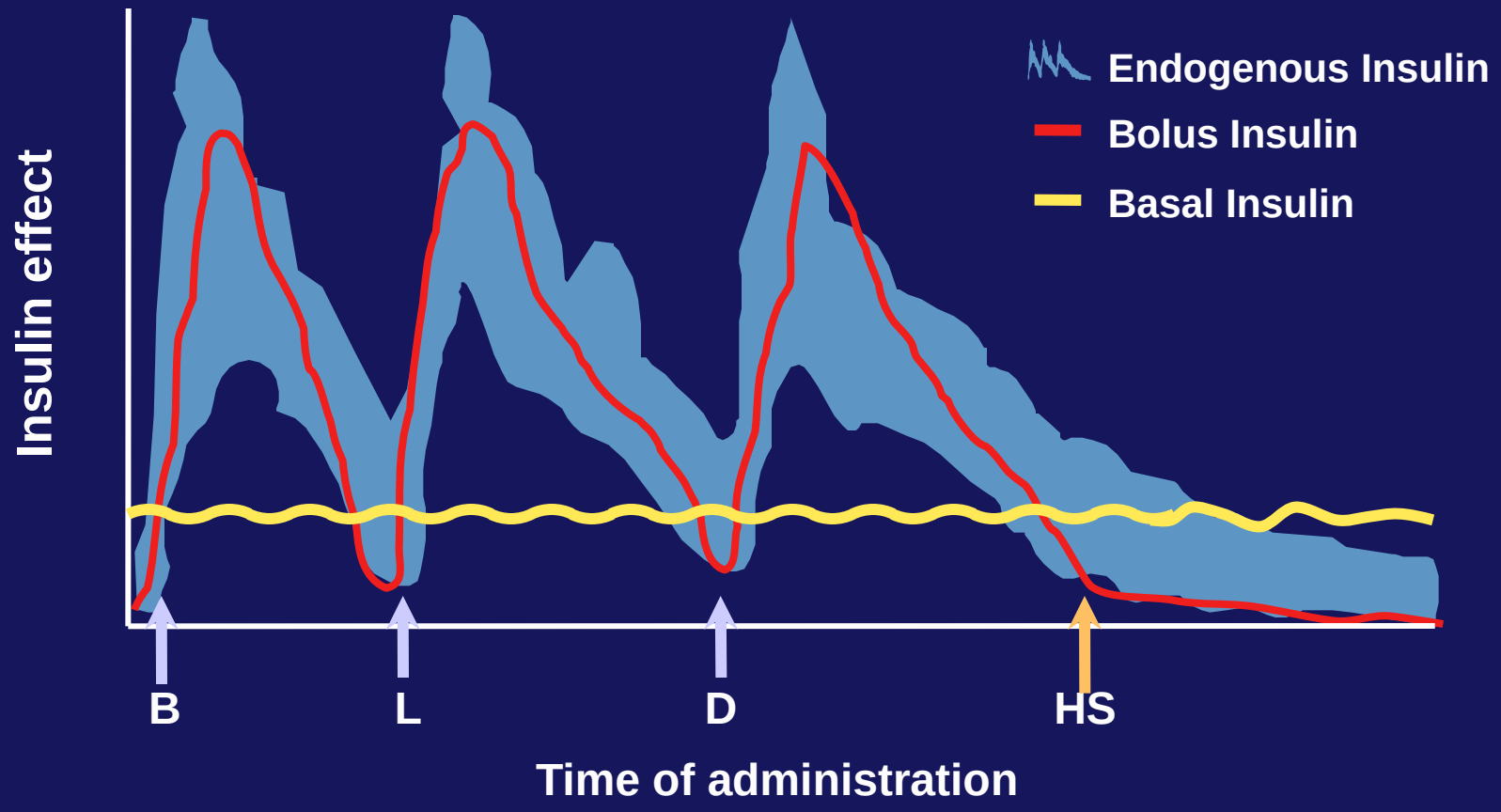
Basal-Bolus



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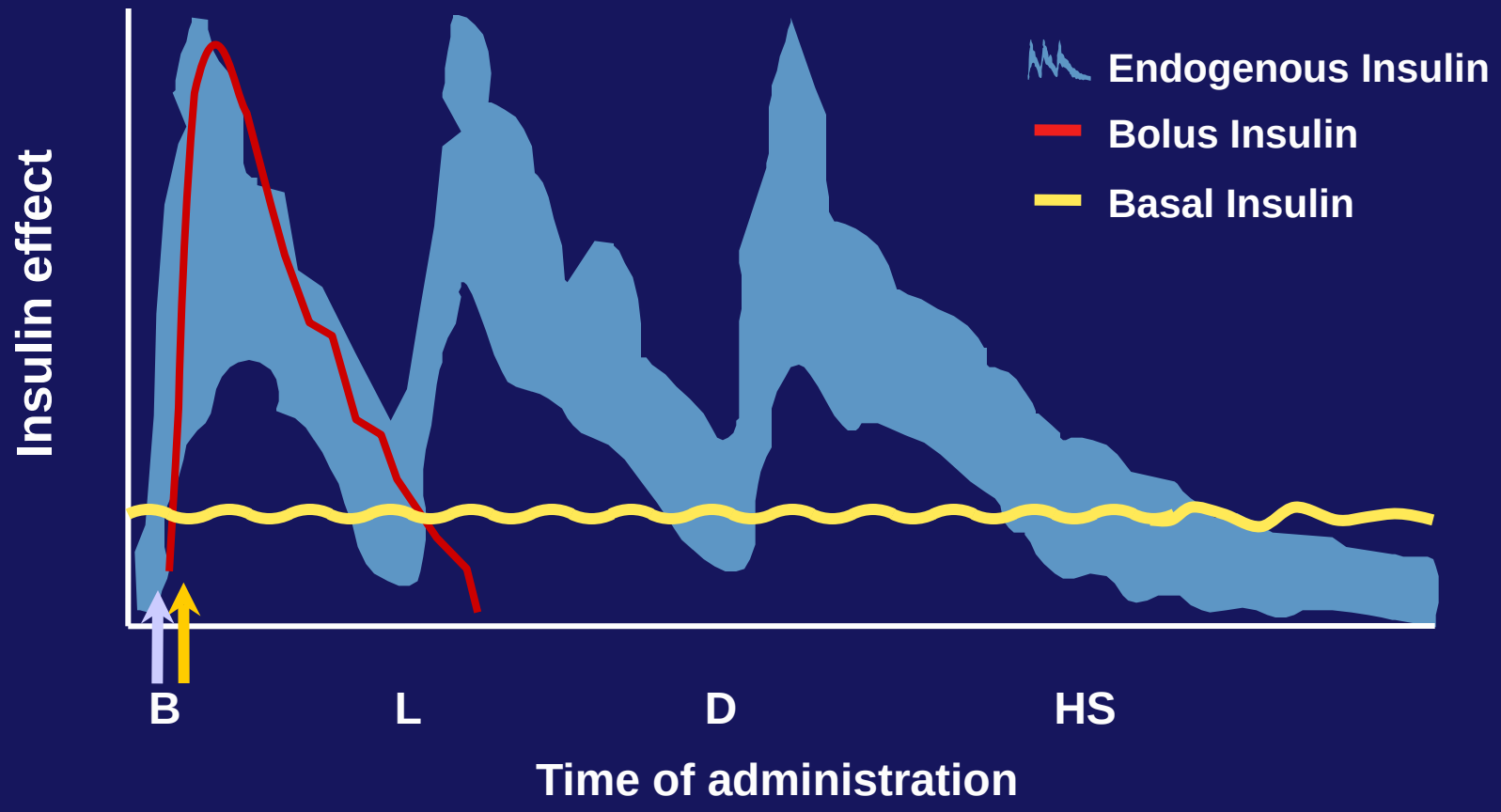
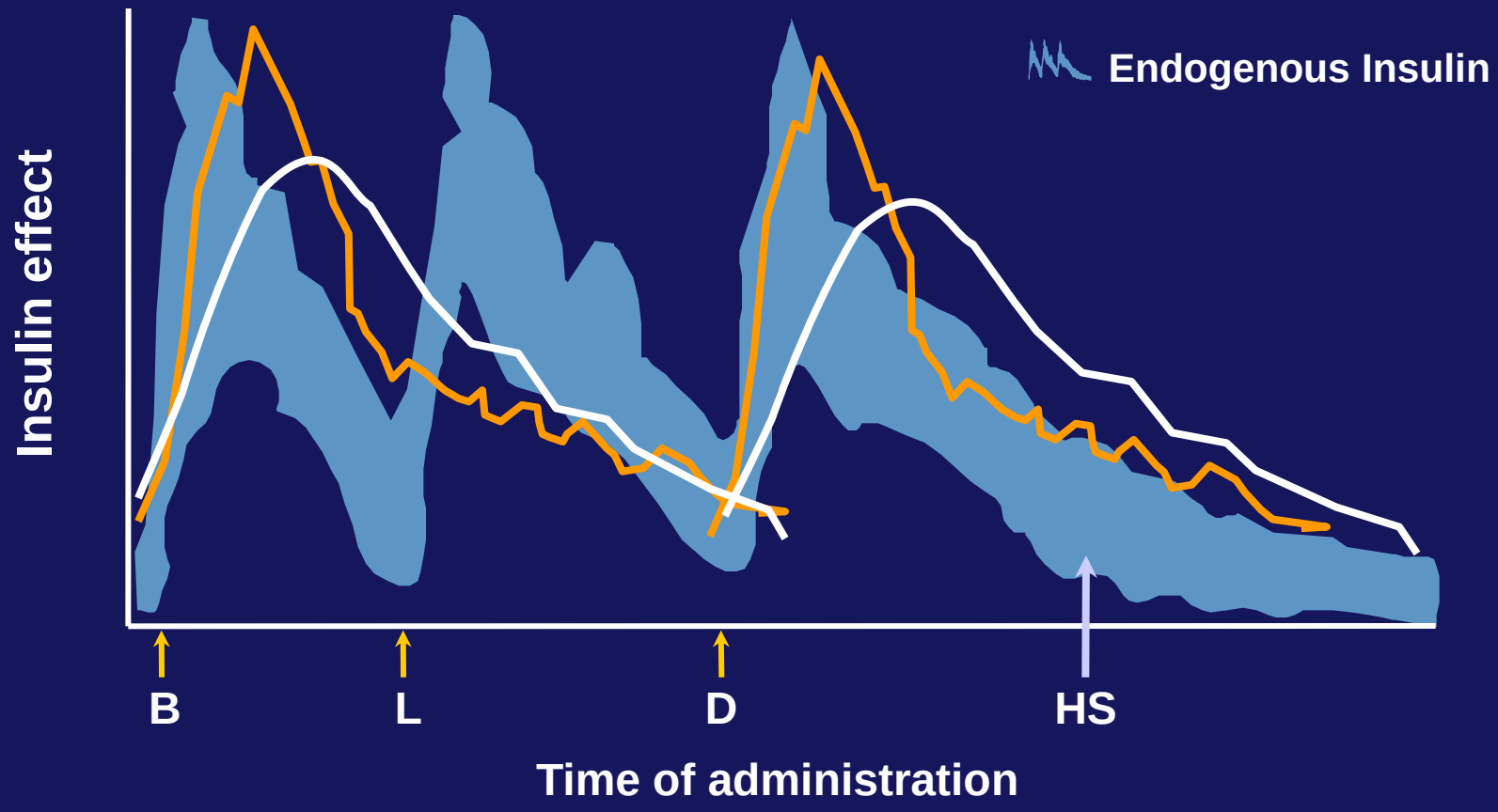
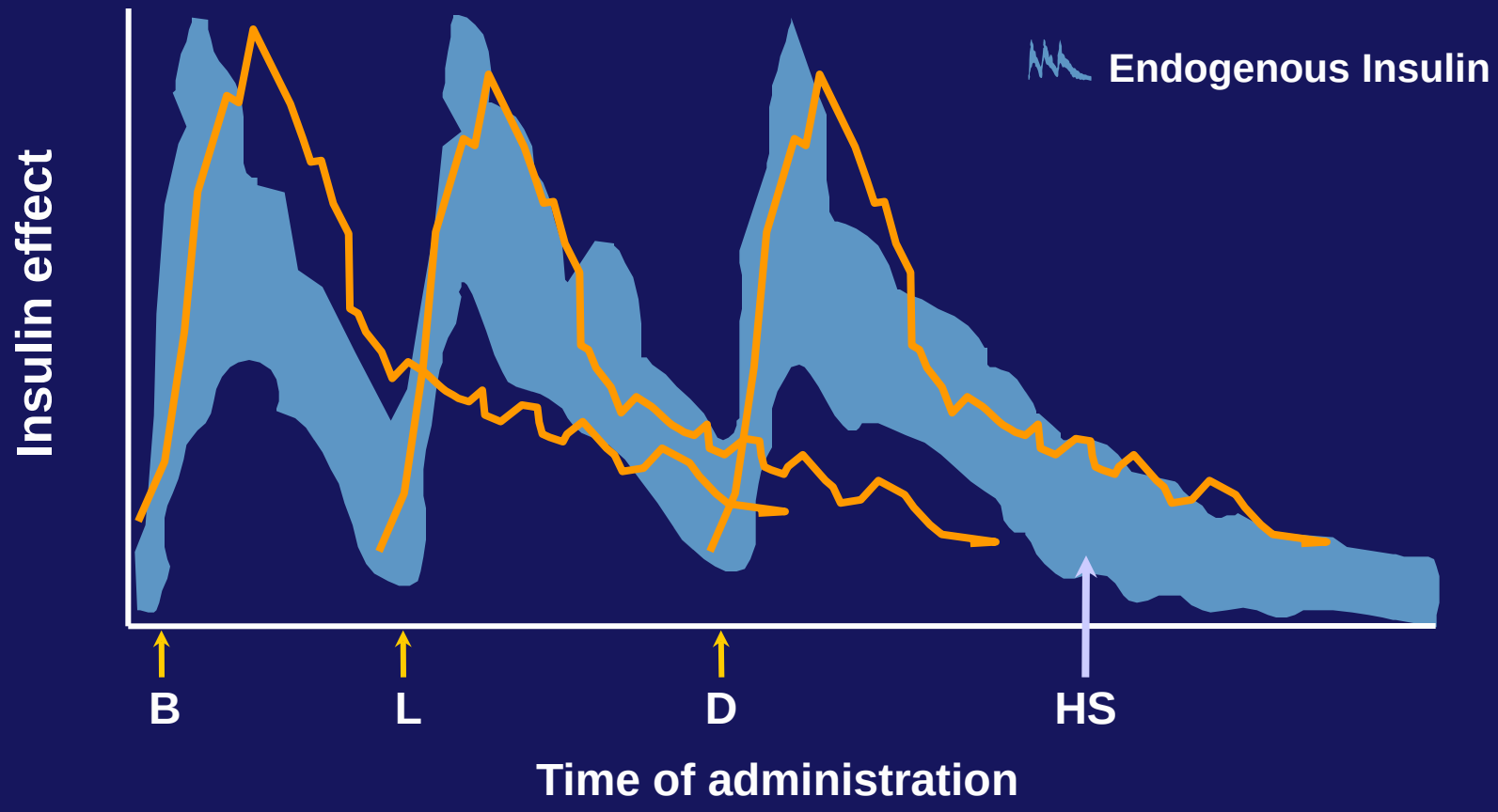
Basal Plus Bolus



BID Premixed



TID Premixed

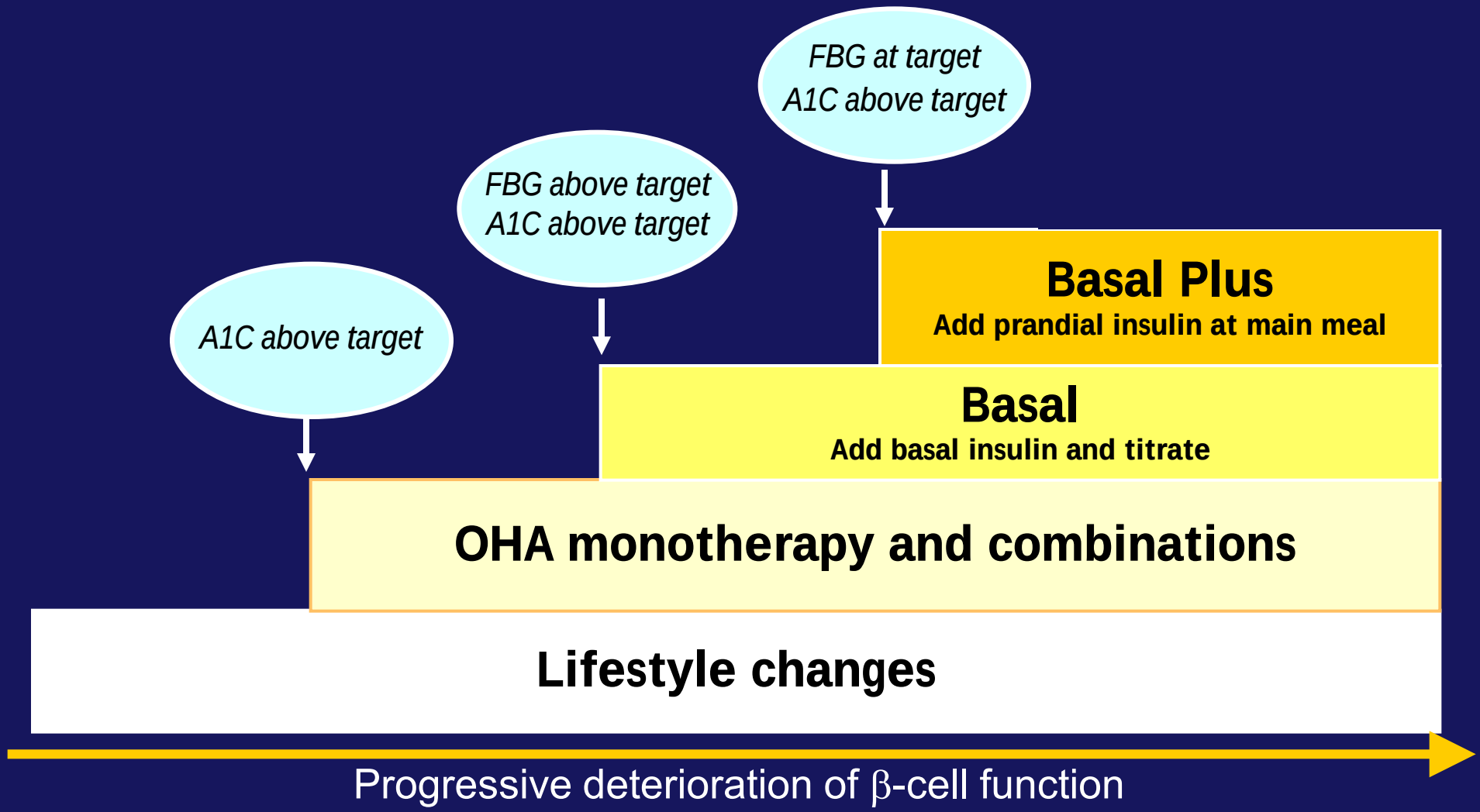


How do the regimens compare?

- Basal start has advantages (4T)
- Diabetes is PROGRESSIVE
- The regimen must change over time
- All roads lead to Basal Bolus concept

- If you're not going to **TITRATE** – don't start

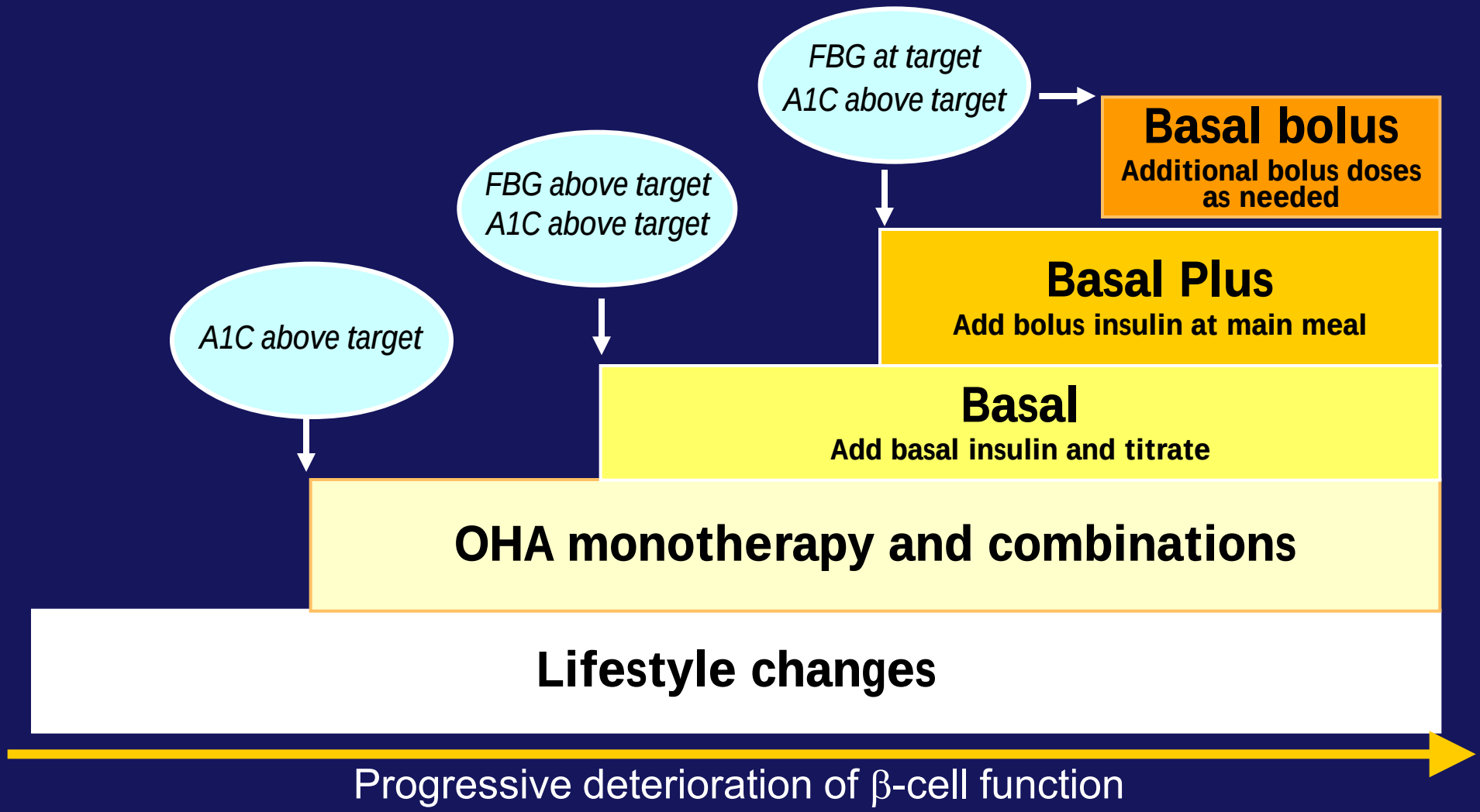
Intensification of Therapy in T2DM



OHA=oral hypoglycaemic agent

Adapted from Raccah D. et al. Diabetes/Met Res & Rev 2007;23:257-64.

Intensification of Therapy in T2DM



OHA=oral hypoglycaemic agent

Adapted from Raccah D. et al. Diabetes/Met Res & Rev 2007;23:257-64.

How to dose?

"Whatever you pick will be WRONG … and that's okay!"

"If you're not going to TITRATE… don't start!"

Basal insulin self-titration tool

- You will inject 10 units of insulin each night
- You will continue to increase by 1 unit every night until your blood sugar level is 4-7 mmol/L before breakfast
- Do not increase your insulin when your fasting blood sugar is 4-7 mmol/L

Please refer to the tear-off pad

Basal Plus or Basal-Bolus

- If full Basal-Bolus: 0.5 u/kg = TDI
- 50% bolus, 50% basal (or 60:40)

OR

- Add 10% of basal dose as bolus [illegible]al (4-T study)

- Add [illegible] titrate (START protocol)

OR

- Add 4 units and self-titrate (STEP protocol)

Pick a number and start!!

Holman RR et al. N Engl J Med 2009:361:1736-47
Harris SB et al. Diabetes Care 2014;37:604-10.
Meneghini L et al. Endocr Pract 2011;17::727-36.

Bolus insulin self-titration tool

- You will inject 2 units of bolus insulin before breakfast
- You will continue to increase by 1 unit every morning until your 2-hour after breakfast blood sugar level is 5-8 mmol/L
- Do not increase your insulin when your 2-hour after breakfast blood sugar is 5-8 mmol/L

Harris SB et al. Diabetes Care 2014;37:604-10.

Premixed

- 0.5 units / kg = TDI
- 2/3 in the AM + 1/3 in the PM

- 5-10 units BID

What about the orals?

- METFORMIN
- METFORMIN
- METFORMIN

- Secretagogues if basal alone
- TZD – stop
- DPP-4 – benefit but cost
- GLP-1 receptor agonist – benefit (dose & weight) but cost
- SGLT2 inhibitor – benefit but cost

How to approach logbook?

1. Where are the lows / highs?
2. Why are there lows / highs?
3. Do I adjust / switch or add?
    a) Titrate to avoid hypoglycemia first
    b) Titrate to reduce hyperglycemia

How much to titrate by?

2 units OR 10%

“Not an exact science … trial and error!”

Cases

Patrick

54 year old man with type 2 diabetes diagnosed 5 years ago, comes to see you for his routine diabetes visit. He has generally been feeling well but complains of slightly more fatigue, which he has attributed to getting older. He saw the diabetes nurse educator and dietitian 6 months ago and says that he is trying his best with respect to food and activity levels but finds it challenging because he is on the road so much as part of his job in sales.

- PMH: Hypertension, dyslipidemia, appendectomy, ex-smoker (quit 5 years ago)

- Meds: Metformin 1g BID, gliclazide MR 120 mg OD, sitagliptin 100 mg OD, acarbose 50 mg TID, simvastatin 40 mg qhs, perindopril 8 mg OD, amlodipine 5 mg OD

- On exam: Obese (wt 100kg, ht 175 cm, WC 104 cm), BP 130/80 mmHg, HR 72 regular. Acanthosis nigricans noted. Eyes – no abnormality. Chest, cardiac, abdominal exams normal. Monofilament sensation normal. Feet unremarkable.

- Labs: A1c 8.2%; TC 4.23, TG 1.99, HDL 1.00, LDL 1.9 mmol/L; Cr 125 umol/L; ACR 2.3

Log Book

	Breakfast		Lunch		Dinner		Bedtime	Insulin Dose
	Before	After	Before	After	Before	After		
Monday	10.2		9.7		11.5		12.2	
Tuesday	9.8				10.1			
Wednesday	8.7		12.5				8.4	
Thursday	10.4				7.6			
Friday	10.1		8.7				13.1	
Saturday	9.9		9.4		9.2		9.9	
Sunday	8.7		10.2		11.8		13.8	

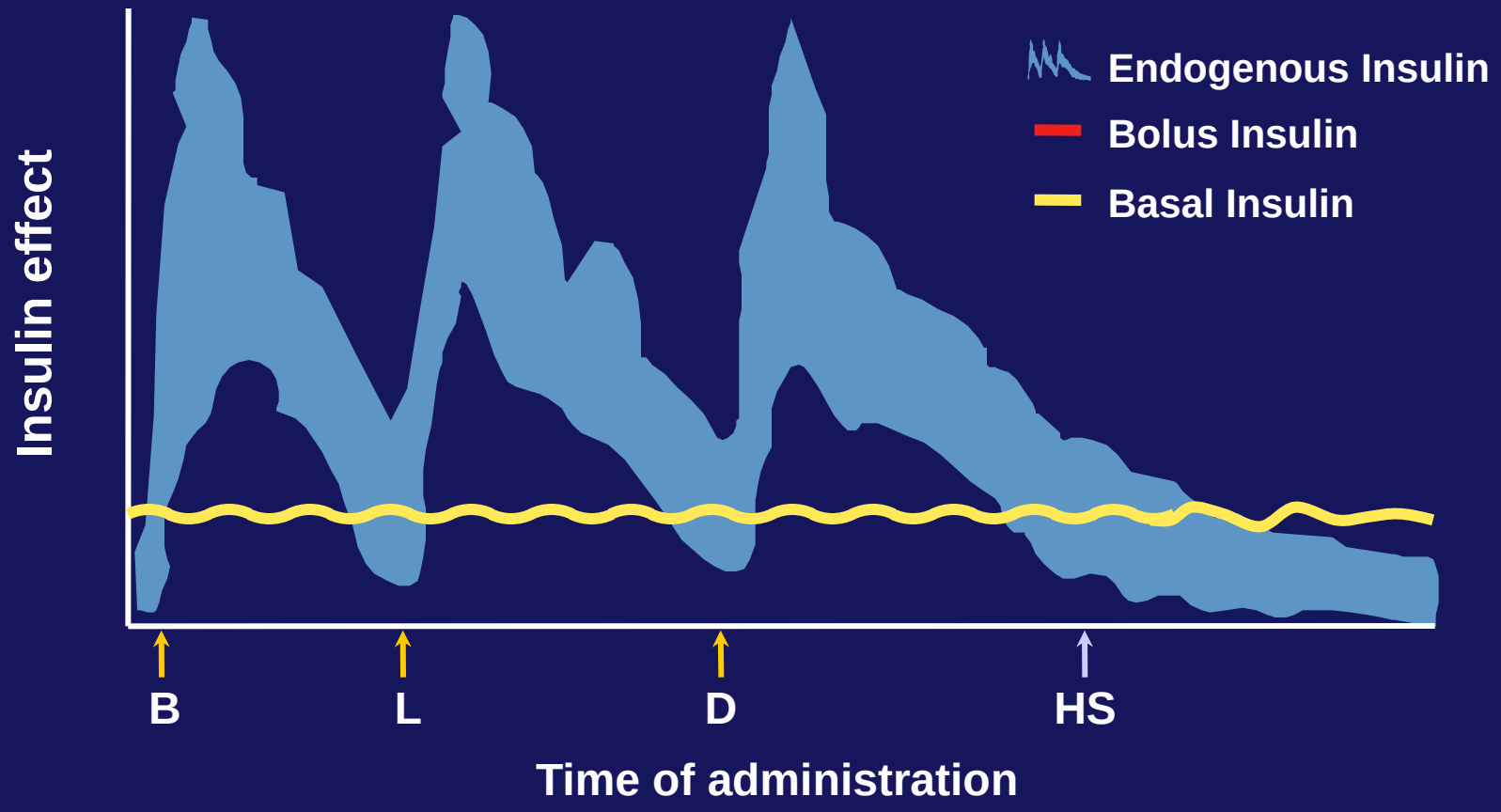
Where are the lows and highs?
Why are there lows and highs?
Adjust / switch / add?

What is your next step?

1. Add basal insulin and keep the SU
2. Add basal insulin and stop the SU
3. Add premixed BID and stop the SU
4. Add Basal Bolus and stop the SU
5. Add Basal and one Bolus

What about the other orals?

Basal insulin



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2. Bolli GB, et al. Diabetologia 1999; 42:1151-67.

Insulin Dosage Instructions (Example)

- Your target fasting blood sugar level is 4-7 mmol/L
- You will inject 10 units of insulin each day
- You will continue to increase by 1 unit every day until your blood sugar level is 4-7 mmol/L before breakfast
- Do not increase your insulin when your fasting blood sugar is 4-7 mmol/L

Please refer to the tear-off pad

	Breakfast		Lunch		Supper			
	Before	After	Before	After	Before	After	Bedtime	Dose
Sunday	9.7				7.8		7.5	22
Monday	9.4				7.6		6.9	23
Tuesday	9.0		8.9		6.5		7.8	24
Wednesday	9.1		8.5				7.5	25
Thursday	8.8							

Metformin 1000 mg p.o. b.i.d.
Gliclazide MR 120 mg p.o. o.d.
Acarbose and Sitagliptin were d/c'd to convince him to go on insulin

What is your next step?

1. Keep titrating the basal
2. Add bolus insulin
3. Change to premixed BID
4. Add basal in the AM
5. Add GLP-1 analogue

- Patrick has been titrating up his long-acting basal insulin at bedtime as instructed and has achieved the target fasting blood glucose levels of 4-7 mmol/L. He remains on metformin 1g BID and gliclazide MR 120 mg od. He has no symptoms of hypoglycemia. Here is his logbook. What should be done now?

	Breakfast		Lunch		Dinner		Bedtime	Insulin Dose
	Before	After	Before	After	Before	After		
Monday	7.7		7.1				6.2	45
Tuesday	8.3				4.9			46
Wednesday	7.1		6.3				7.3	47
Thursday	6.9				4.4			47
Friday	9.0		5.9		4.1		5.9	48
Saturday	8.1				4.0			49
Sunday	8.2		8.9		4.0		6.1	50

Where are the lows and highs?
Why are there lows and highs?
Adjust / switch / add?

What would you do now?

1. Add basal in the morning
2. Increase the basal at bedtime
3. Reduce/stop the gliclazide MR
4. Change to premixed BID
5. 2+3

	Breakfast		Lunch		Dinner		Bedtime	Insulin Dose
	Before	After	Before	After	Before	After		
Monday	7.7		7.1				6.2	45
Tuesday	8.3				4.9			46
Wednesday	7.1		6.3				7.3	47
Thursday	6.9				4.4			47
Friday	9.0		5.9		4.1		5.9	48
Saturday	8.1				4.0			49
Sunday	8.2		8.9		4.0		6.1	50

Where are the lows and highs?
Why are there lows and highs?
Adjust / switch / add?

	Breakfast		Lunch		Dinner		Bedtime	Insulin Dose
	Before	After	Before	After	Before	After		
Monday	7.7		7.1				6.2	45
Tuesday	8.3				4.9			46
We								
Th								
Fri								
Sa								
Sunday	8.2		8.9		4.0		6.1	50

Continue increasing bedtime basal insulin

Decrease gliclazide MR dose

Where are the lows and highs?
Why are there lows and highs?
Adjust / switch / add?

	Breakfast		Lunch		Supper			
	Before	After	Before	After	Before	After	Bedtime	Dose
Sunday	6.5						7.2	55
Monday	5.9		5.9		5.7		6.9	55
Tuesday	5.7		5.5		6.0		6.7	55
Wednesday	5.8		5.8		6.2		6.5	55
Thursday	5.5		5.1					

Metformin 1000 mg p.o. b.i.d.
Gliclazide MR 90 mg p.o. o.d.


30
27
28
29
30
28
29
30
5
10

Patrick (3 years later)

He has generally been feeling well but says that his sugars are no longer as well controlled as they have been in the past. He continues to try his best with respect to food and activity levels but continues to find it challenging because he is on the road so much as part of his job in sales.

For his diabetes management, you had started him on long-acting bedtime basal insulin 3 years ago and he responded well to the treatment with A1c maintained below 7% for the last 3 years, although it has risen slightly above 7% at the last visit 4 months ago.

- Meds: Metformin 1g BID, gliclazide MR 120 mg OD, glargine 55 units qhs, simvastatin 40 mg qhs, perindopril 8 mg od, amlodipine 10 mg od

- On exam: Obese (wt 104kg, ht 175 cm, WC 108 cm), BP 120/80 mmHg, HR 72 regular. Acanthosis nigricans noted. Eyes – no abnormality. Rest normal.

- Labs: A1c 8.1%; Cr 130 umol/L

Why did Patrick need his gliclazide MR to be increased back to 120 mg over time?

	Breakfast		Lunch		Dinner		Bedtime	Insulin Dose
	Before	After	Before	After	Before	After		
Monday	5.9		10.0		7.5			55
Tuesday	6.1	12.3			7.1		7.8	55
Wednesday	5.5		8.7					55
Thursday	5.8	10.1			7.6		6.1	55
Friday	5.2		8.1				6.4	55
Saturday	6.4	11.5			6.9			55
Sunday	7.1		9.1		6.4		5.9	55

Where are the lows and highs?
Why are there lows and highs?
Adjust / switch / add?

What would you do next?

1. Add basal in the morning
2. Increase the basal at bedtime
3. Change to premixed BID
4. Add bolus insulin at all meals
5. Add bolus insulin at breakfast

	Breakfast		Lunch		Dinner		Bedtime	Insulin Dose
	Before	After	Before	After	Before	After		
Monday	5.9		10.0		7.5			55
Tuesday	6.1	12.3			7.1		7.8	55
Wedn								
Thursday	5.8	10.1			7.6		6.1	55
Friday	5.2		8.1				6.4	55
Saturday	6.4	11.5			6.9			55
Sunday	7.1		9.1		6.4		5.9	55

Add bolus insulin at breakfast

Where are the lows and highs?
Why are there lows and highs?
Adjust / switch / add?

If you were to add bolus at breakfast, how much?

1. 2 units
2. 4 units
3. 8 units
4. 20 units

Beverley

55 year old woman, school teacher, type 2 diabetes for last 10 years, is coming to see you for her routine diabetes management. She has generally been feeling well and has no specific complaints. She is followed regularly by her eye doctor and denies any symptoms of complications from diabetes.

- PMH: Hypertension, dyslipidemia, menopause, osteoporosis – no fractures, depression
- Meds: Metformin 1g BID, gliclazide MR 120 mg OD, NPH 45 units qhs, atorvastatin 10 mg od, ramipril 10 mg od, citalopram 20 mg od
- On exam: Overweight (wt 95kg, ht 160 cm, WC 114 cm), BP 125/70 mmHg, HR 72 regular. Acanthosis nigricans noted. Rest normal.
- Labs: A1c 6.9%; Cr 76 umol/L

	Breakfast		Lunch		Dinner		Bedtime	Insulin Dose
	Before	After	Before	After	Before	After		
Monday	10.2		7.1		7.6		6.2	45
Tuesday	9.8				8.8		10.4	45
Wednesday	4.1		6.3		5.4		7.3	45
Thursday	6.1						9.6	45
Friday	3.9		5.9		6.1		5.9	45
Saturday	10.6		6.1		4.9		5.3	45
Sunday	12.4		8.9		7.1		6.1	45

Where are the lows and highs?
Why are there lows and highs?
Adjust / switch / add?

On further questioning, Beverley states that she has occasional nightmares and wakes up with headaches or not feeling rested. She has also noticed that if she takes her bedtime snack or has a late large dinner, she feels better in the morning but she stopped doing that because of concerns with weight gain.

What are you concerned about?

What will you ask her to do?

You ask her to perform several 3 AM blood glucose measurements and they confirm nocturnal hypoglycemia with readings in the 3's.

Definition of Hypoglycemia

1. Development of neurogenic or neuroglycopenic symptoms

Neurogenic (autonomic)	Neuroglycopenic
Trembling	Difficulty Concentrating
Palpitations	Confusion
Sweating	Weakness
Anxiety	Drowsiness
Hunger	Vision Changes
Nausea	Difficulty Speaking
	Dizziness

2. Low blood glucose (<4 mmol/L if on insulin or secretagogue)
3. Response to carbohydrate load

Canadian Diabetes Association

Severity of Hypoglycemia

- **Mild**
  - Autonomic symptoms present
  - Individual is able to self-treat
- **Moderate**
  - Autonomic and neuroglycopenic symptoms
  - Individual is able to self-treat
- **Severe**
  - Requires the assistance of another person
  - Unconsciousness may occur
  - Plasma glucose is typically <2.8 mmol/L

Canadian Diabetes Association

- Adjust/switch/add?

- After lowering her gliclazide MR dose and trying a lower dose of the NPH at bedtime, Beverley still found that she would get nocturnal hypoglycemia certain nights, despite no change in her routine, the decision was made to change to a long-acting basal analogue insulin. She was taking NPH 35 units qhs.

What dose of basal analogue?

1. 10 units
2. 36 units (her current dose)
3. 48 units (0.5 units/kg)
4. 95 units (1.0 units/kg)
5. Doesn’t really matter!

Insulin Dosage Instructions (Example)

- Your target fasting blood sugar level is 4-7 mmol/L
- You will inject 36 units of insulin each day
- You will continue to increase by 1 unit every day until your blood sugar level is 4-7 mmol/L before breakfast
- Do not increase your insulin when your fasting blood sugar is 4-7 mmol/L

Deanna

51 year old woman with type 2 diabetes for the last 8 years, is coming to see you for her routine diabetes care. Her diabetes is complicated by early retinopathy and microalbuminuria (ACR 2.2 mg/mmol, eGFR 65 mL/min). After 7 years of being on oral antihyperglycemic agents for her diabetes with poor glycemic control, she finally agreed to insulin therapy last year. She was placed on 30/70 insulin – 40 units before breakfast and 20 units before supper.

- As a nurse on the psychiatry ward, she works either a 12-hour day (0700h to 1900h) or 12-hour night (1900h to 0700h) shift. She was not sure how to time her 30/70 insulin appropriately and therefore, tries to take the 30/70 at the same time everyday (0800h and 2000h) and is consistent with the timing of those 2 meals. However, the 3rd meal and snack varies depending on her work schedule and sleep time.

- Meds: 30/70 insulin 40 units at 0800h and 20 units at 2000h, metformin 1g bid, rosuvastatin 20 mg od, irbesartan/HCTZ 300/25 mg od, ECASA 81 mg od

	Morning			Evening				Work Hours
	0800h	Insulin	afternoon	2000h	Insulin	2400h	0400h	
Monday	7.8	40	2.8	10.1	20	8.8		Day
Tuesday	5.8	40	7.8	6.4	20			Day
Wed	6.3	40	8.1	5.5	20	8.9		Off
Thursday	6.4	40	5.6	7.8	20	3.4		Night
Friday	14.1	40	3.1 (1400h)	9.6	20	8.9	10.1	Night
Saturday	11.6	40	3.5 (1430h)	8.3	20	6.4	9.9	Night
Sunday	12.4	40	4.0 (1500h)	8.9	20		11.8	Night

Where are the lows and highs?
Why are there lows and highs?
Adjust / switch / add?

	Morning			Evening				Work Hours
	0800h	Insulin	afternoon	2000h	Insulin	2400h	0400h	
Monday	7.8	40	2.8	10.1	20	8.8		Day
Tuesday	5.8	40	7.8	6.4	20			Day
Wed								
Thursday	6.4	40	5.6	7.8	20	3.4		Night
Friday	14.1	40	3.1 (1400h)	9.6	20	8.9	10.1	Night
Saturday	11.6	40	3.5 (1430h)	8.3	20	6.4	9.9	Night
Sunday	12.4	40	4.0 (1500h)	8.9	20		11.8	Night

Change to basal-bolus

Where are the lows and highs?
Why are there lows and highs?
Adjust / switch / add?

How would you dose the BBT?

James

- 66 year old man, 96 kg
- T2DM x 5 years on metformin/ glyburide
- Admitted for urosepsis
- A1c 8.0%
- Not eating and drinking well
- Creatinine 245 umol/L, eGFR 27 mL/min

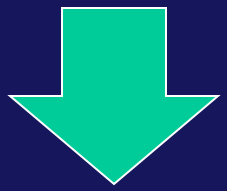
What would you do now?

1. Sliding scale bolus insulin QID
2. Start IV insulin
3. Resume oral agents
4. Basal + bolus therapy
5. Basal insulin SC OD

What are the issues in a patient with renal failure?

Considerations in renal failure

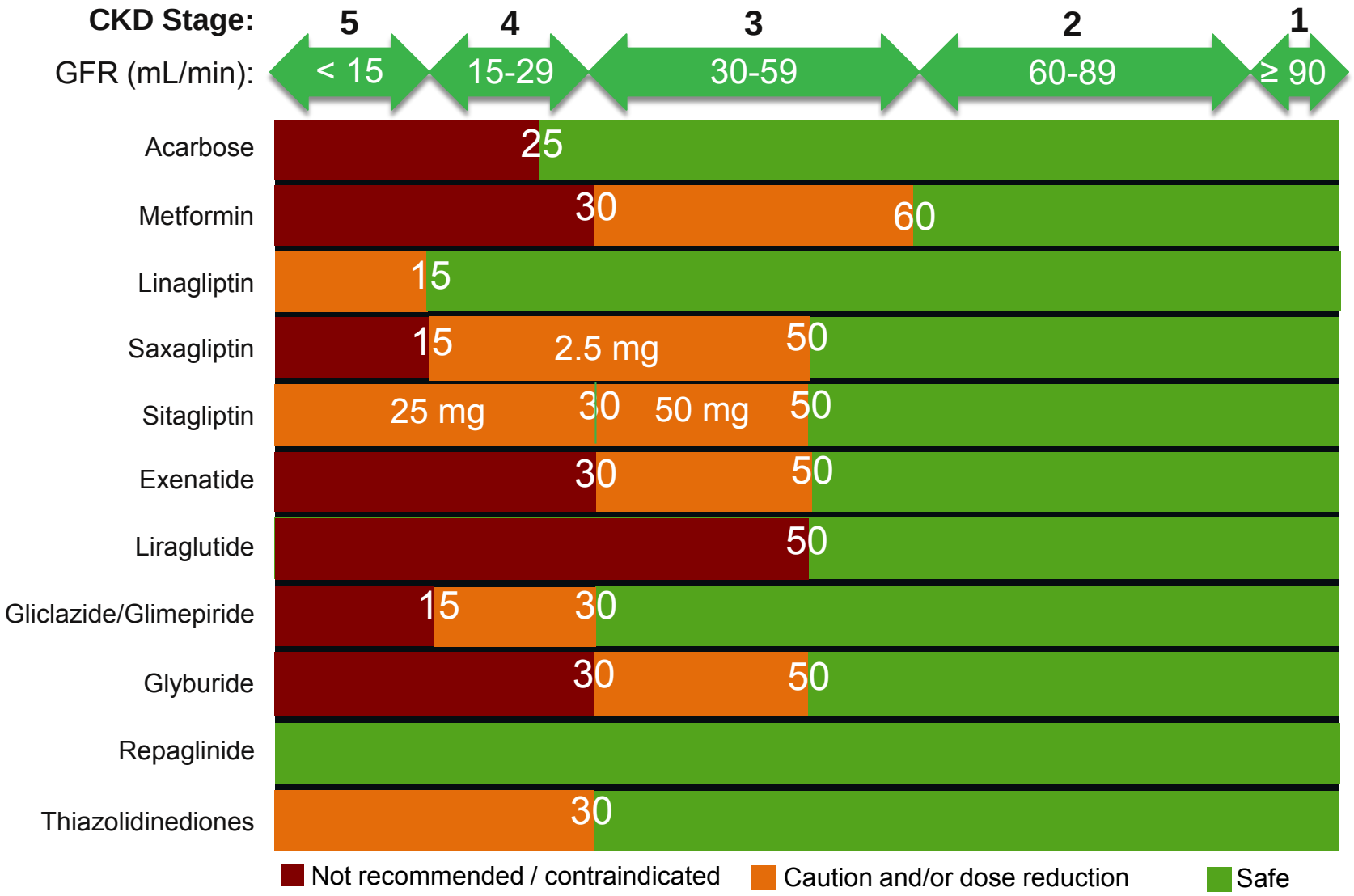
- Limitations of therapies
- Reduced clearance of insulin
- Reduced renal gluconeogenesis
- Altered eating habits



INCREASED HYPOGLYCEMIA

Park J et al. Curr Diab Rep 2012;12:432-39.

Antihyperglycemic agents and Renal Function



Adapted from: Product Monographs as of March 1, 2013; CDA Guidelines 2008; and Yale JF. J Am Soc Nephrol 2005; 16:S7-S10.

1. Sliding scale bolus insulin QID
2. Start IV insulin
3. ~~Resume oral agents~~
4. Basal + bolus therapy
5. Basal insulin SC OD

- Humulin R or Novolin Toronto SC QID

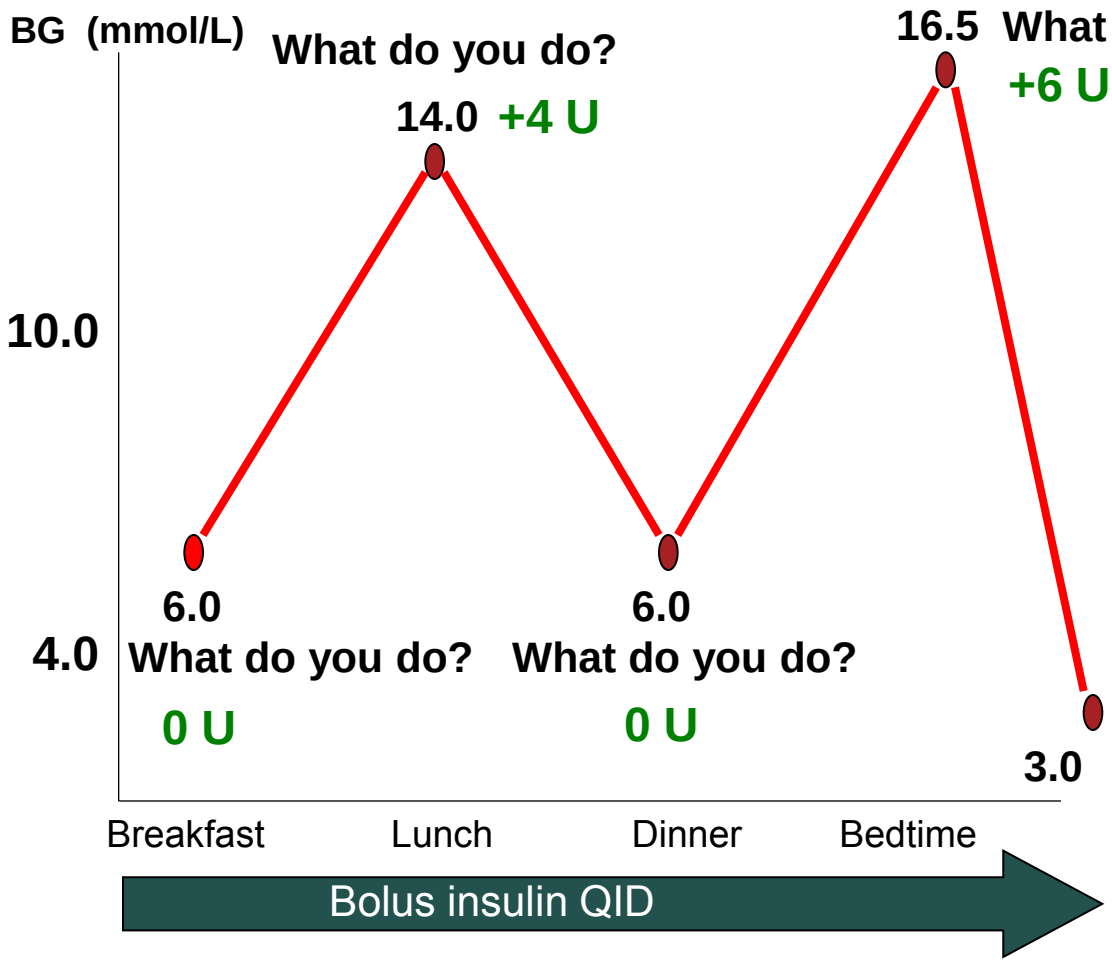
BS	Insulin
<8	0
8.1-12	2 units
12.1-16	4 units
16.1-20	6 units
>20	10 units

Sliding scale insulin - evil

- Sliding scale insulin without a basal insulin is purely REACTIVE and allows for hyperglycemia (Queale WS. et al. *Arch Int Med* 1997;157)

Prolonged therapy with SSI as the sole regimen is discouraged. (AACE/ADA Consensus Statement 2009)

Sliding scale insulin alone results in variable glucose control



Sliding Scale alone

BG (mmol/L)	Bolus insulin (U)
< 4	Call MD
4.1 – 10.0	0
10.1 – 13.0	2
13.1 – 16.0	4
16.1 – 19.0	6
> 19.0	Call MD

QID: four times daily; SSI: sliding-scale insulin; BG: blood glucose

JAMA®

Online article and related content current as of February 27, 2009.

Sliding Scale Insulin Time to Stop Sliding

Irl B. Hirsch

JAMA. 2009;301(2):213-214 (doi:10.1001/jama.2008.943)

http://jama.ama-assn.org/cgi/content/full/301/2/213

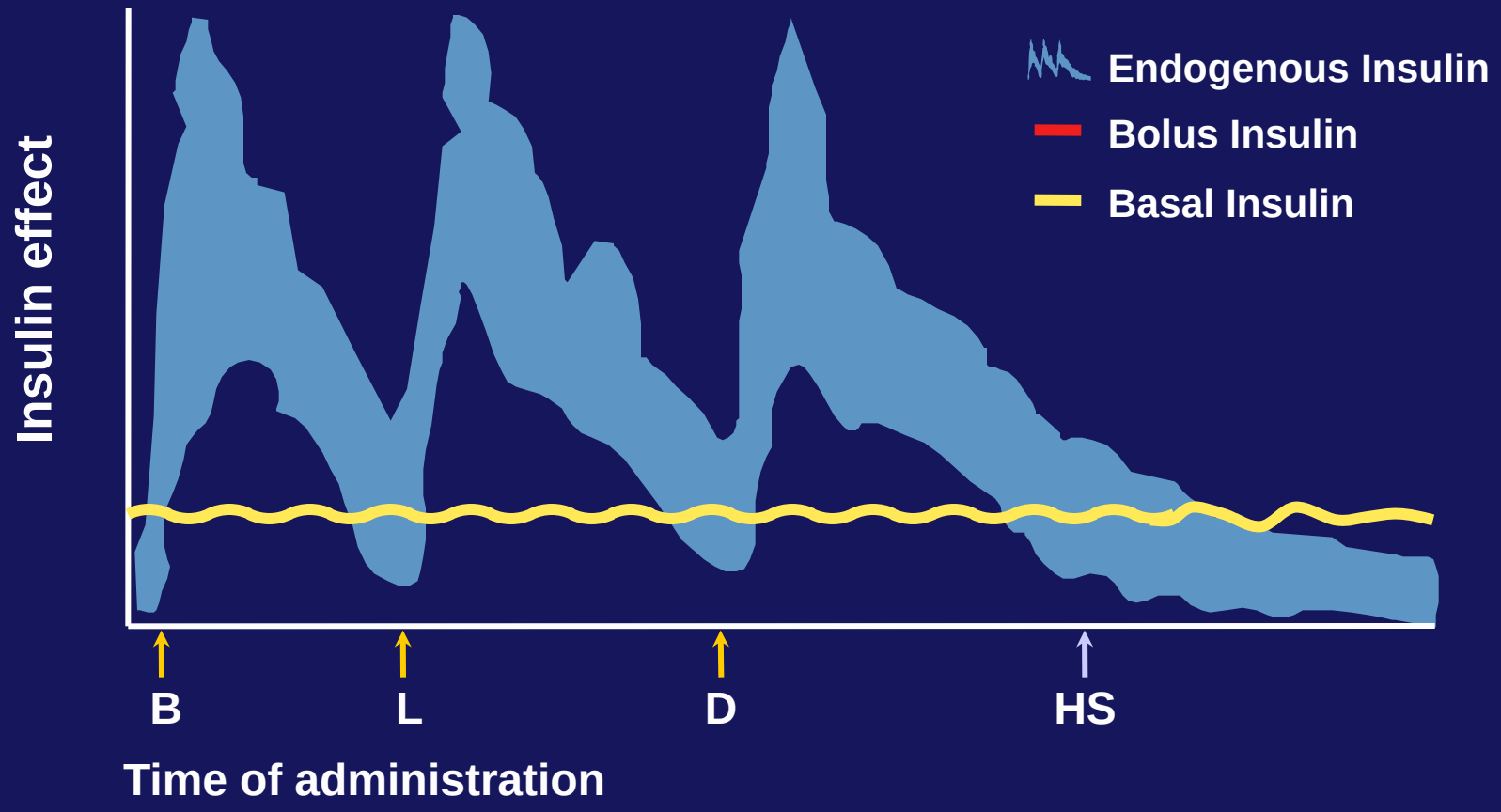
Medical professionals do not use sliding scale penicillin for fever or sliding scale oxygen for pulmonary edema. It is time to discontinue amusement park diabetes therapy so that decades from now clinicians are still not trying to abolish an illogical treatment. Perhaps next July or the following summer, when the senior resident is explaining to the intern hyperglycemia management for a newly admitted patient with pneumonia, the discussion will revolve around basal insulin, prandial insulin, and correction-dose insulin based on a protocol that all hyperglycemic patients receive throughout the entire health care system.

NPO

- IV insulin
  - For 96 kg = TDI (SC) = 0.5u/kg = 48 units/d
  - IV TDI ≈ ½ SC TDI
  - 1.0 units / hr IV insulin at optimal glucose
  - If on home insulin, TDI = total of home dose
- SC long-acting basal analogue OD
  - TDI x 50% = 24 units SC once daily
- SC NPH q12h
  - 12 units SC q12h
  - Or can use the TDI dose given the potential insulin resistance

Wesorick D, et al. *J Hosp Med* 2008;3(5 Suppl):17-28.

Basal insulin



B = breakfast; L = lunch; D = dinner; HS = bedtime.

1. Leahy JL. In: Leahy JL, Cefalu WT (eds). *Insulin Therapy.* Marcel Dekker Inc., New York, 2002.
2. Bolli GB, et al. Diabetologia 1999; 42:1151-67.

Caveats

- Insulin resistance
  - Greater rate of increase in insulin doses for both SC or IV
- Acute infection
  - ++ insulin resistant state
  - Requirements may double
  - Increase requirements by 30%

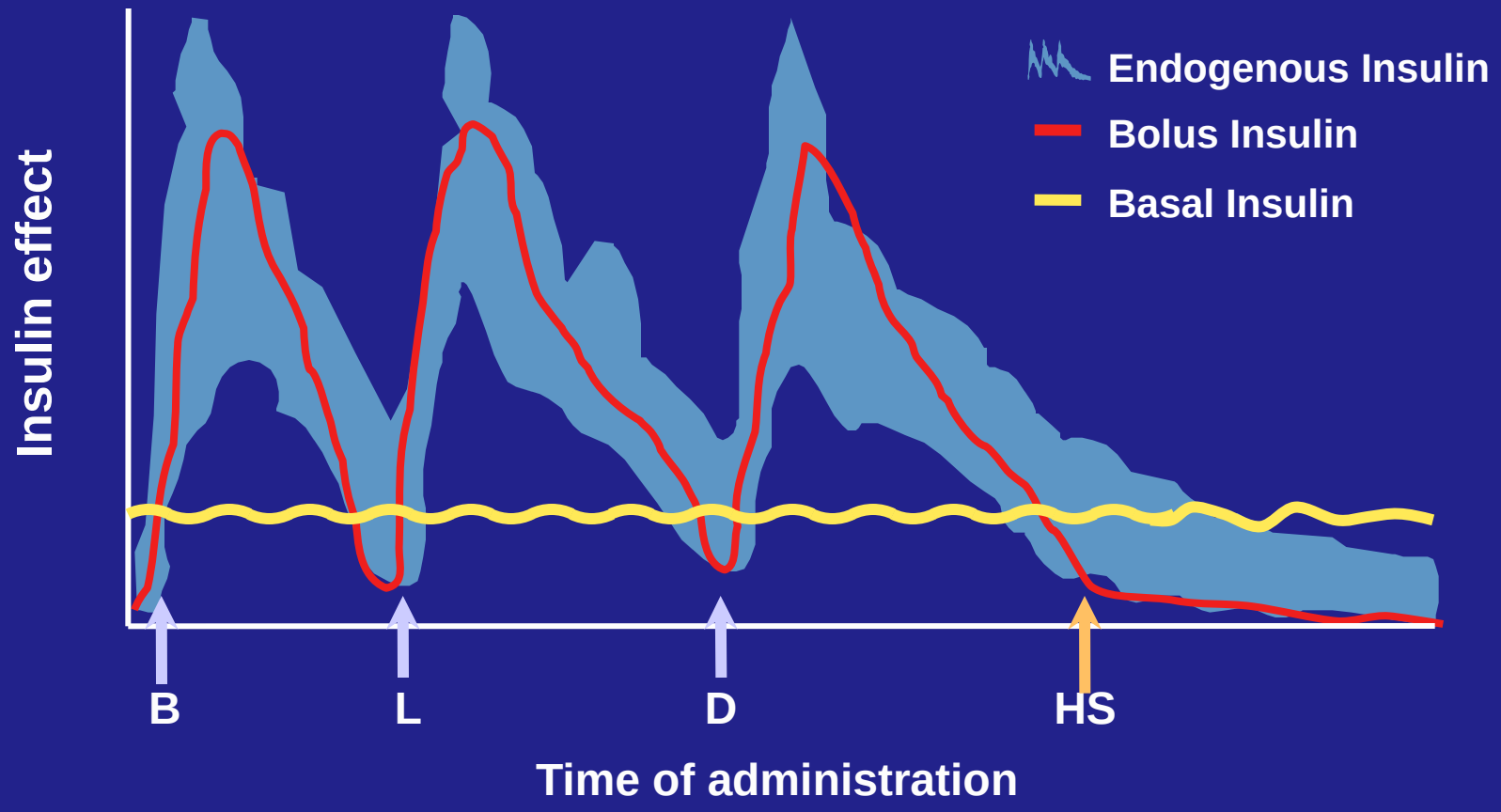
James (cont'd)

- Basal insulin SC continued
- 2 days post-admission, starting to eat and drink
- Cr 195 umol/L

- DM management now?

1. Continue SC basal insulin with no changes
2. Add bolus insulin with each meal + continue basal SC dose + supplemental bolus insulin
3. D/C basal SC insulin - resume oral agents
4. D/C basal SC insulin – begin sliding scale bolus insulin QID

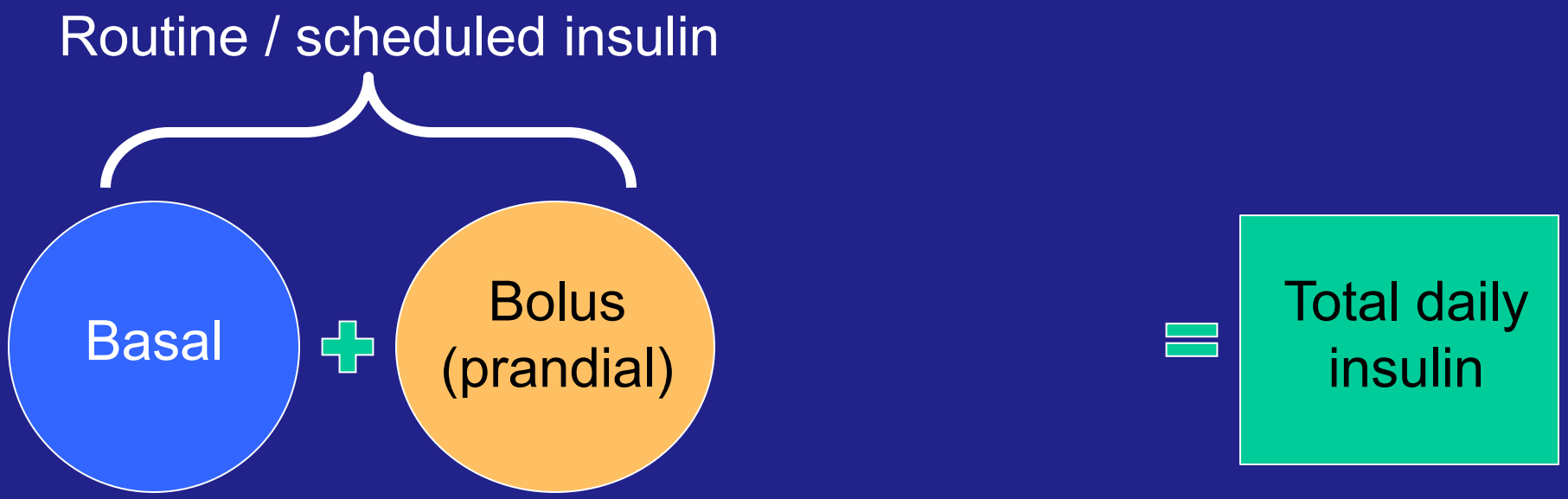
Basal-Bolus



B = breakfast; L = lunch; D = dinner; HS = bedtime.

1. Leahy JL. In: Leahy JL, Cefalu WT (eds). *Insulin Therapy.* Marcel Dekker Inc., New York, 2002.

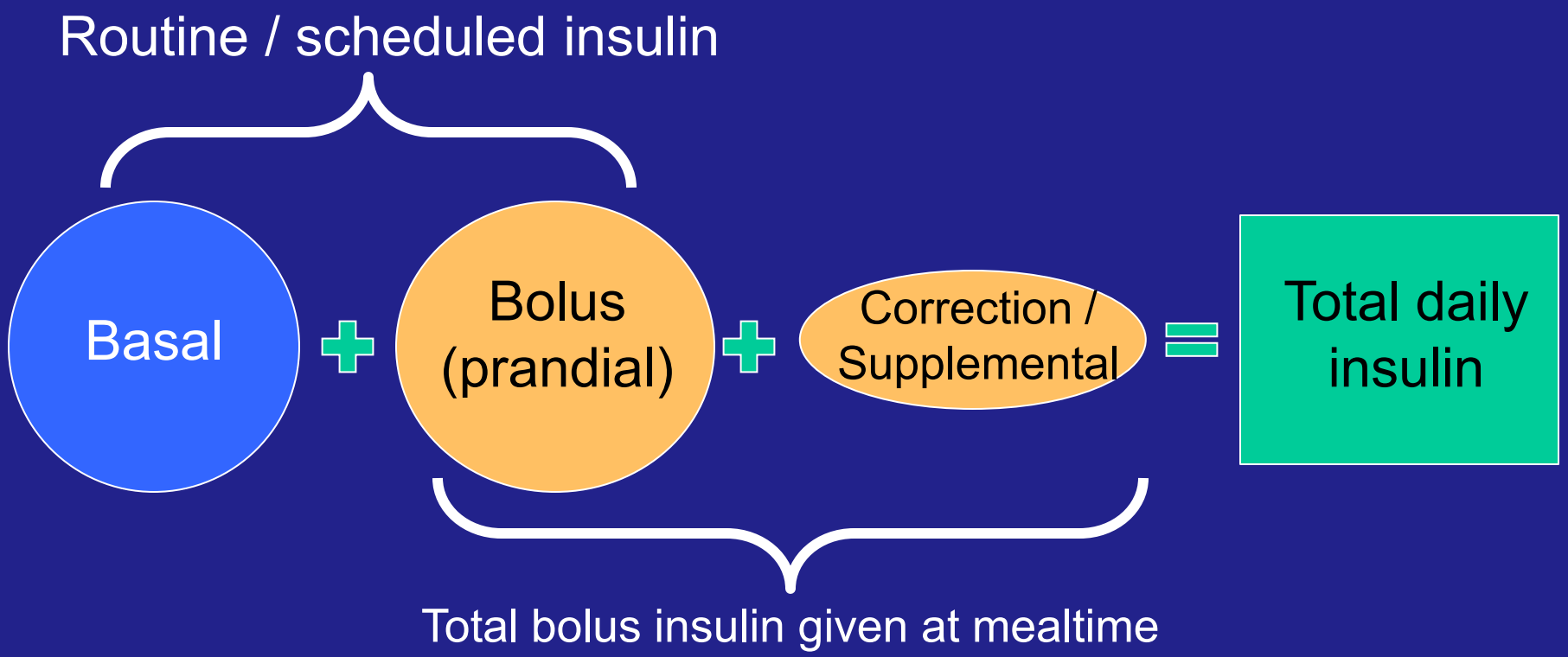
Preferred inpatient insulin administration



Supplemental scale – good!

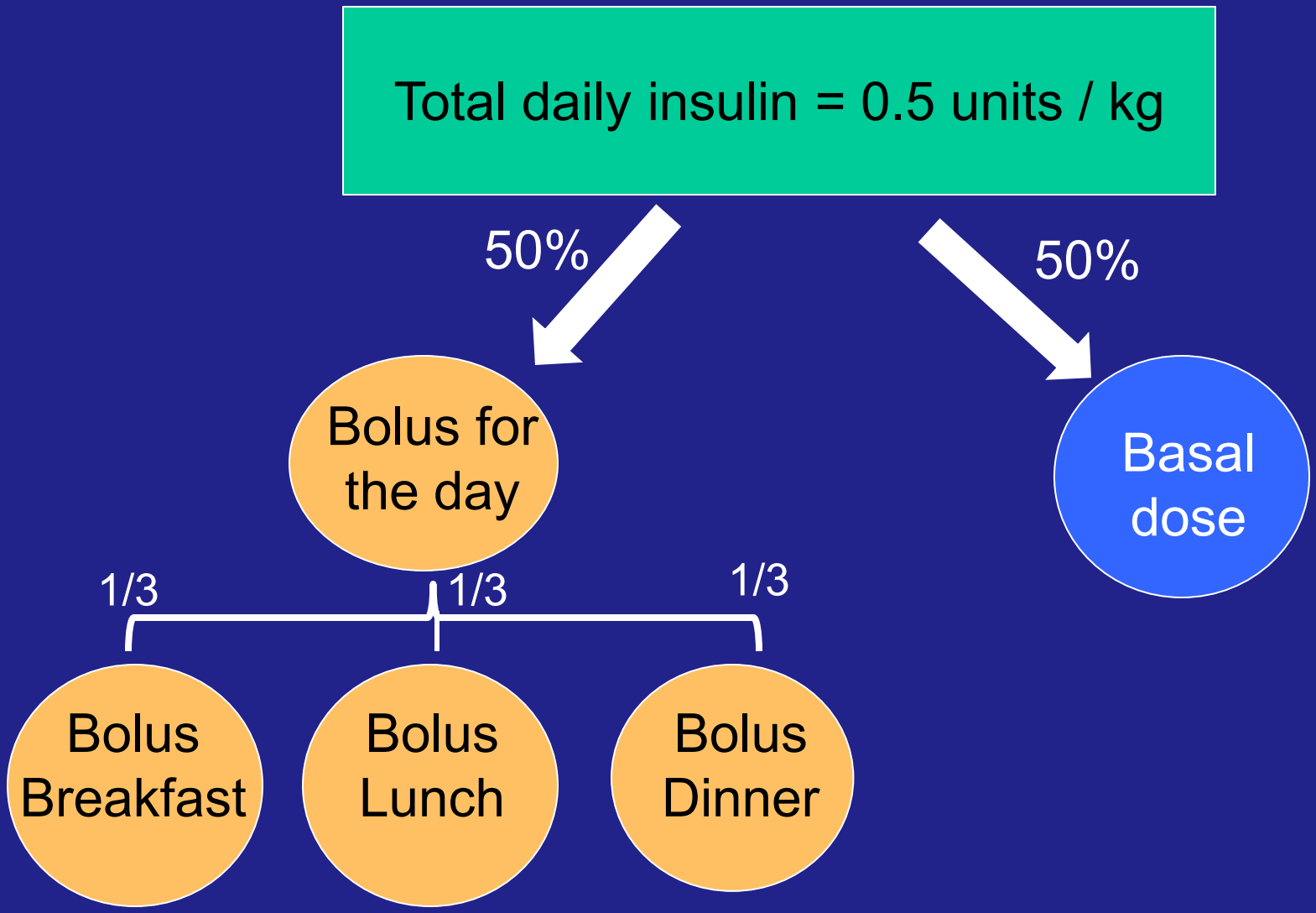
- Supplements ROUTINE insulin
- EXTRA bolus insulin ac meals ONLY
- CORRECTS hyperglycemia
- Can use supplemental needs to reassess standing doses

Preferred inpatient insulin administration



You choose to start basal-bolus regimen with bolus supplemental scale at meals.

What doses will you order?


Total daily insulin = 0.5 units / kg
50%
50%
Bolus for the day
Basal dose
1/3
1/3
1/3
Bolus Breakfast
Bolus Lunch
Bolus Dinner

- Basal 24 units SC qhs
- Bolus 8 units SC ac meals
- Bolus SC supplemental scale ac meals

BS	Insulin
<4	call MD
4.1-10	0 units
10.1-13	2 units
13.1-16	4 units
16.1-19	6 units
>19	10 units

His eating is actually quite variable. How would you modify his insulin regimen to accommodate this?

1. Routine basal + sliding scale bolus
2. Routine basal + routine bolus (***pc*** meals if pt eats > 50% of tray)
3. Supplemental scale bolus only
4. Routine basal only

Variable Eating

- Need BASAL insulin (NPH bid or detemir / glargine OD)
- Can give the BOLUS insulin immediately pc meals

He is having difficulties swallowing and is assessed by speech-language pathology and deemed to be inappropriate for oral intake. He is now on continuous enteral feeds.

1. Routine basal only
2. Routine basal + routine bolus
3. Routine basal + supplemental scale
4. Routine bolus only

Enteral / Parenteral Feeds

- Continuous feeds
  - Detemir or glargine OD
  - NPH q 12 h (not BID!!) (TDI split into 2)
- Bolus feeds
  - Time the insulin dosing to match the feed times
  - Regular insulin can be helpful here
  - Still need basal insulin

James (cont'd)

- Over time, his ability to swallow improves and he is able to tolerate a full oral diet

- He is then stablized on:
  - Basal insulin 25 units qhs
  - Bolus insulin 10 units ac meals
  - Supplement bolus insulin as needed

James (cont'd)

- Just 2 days before planned discharge, he develops acute right knee pain and left great toe pain

- He is diagnosed with gout and is placed on PREDNISONE 40 mg OD x 5 days

What would you do with his insulin regimen?

1. Change nothing – it is only 5 days
2. Wait 2 days to see the pattern, then adjust his insulin
3. Increase the breakfast and lunch bolus doses and continue the dinner bolus and basal doses
4. Increase all the insulin doses

Glucocorticoids

- Prednisone in AM = high glucose at lunch and supper but normal fasting

- Increase existing doses at breakfast and lunch … may need to increase dinner too

Glucocorticoids

- If naïve to insulin …
  - NPH in AM + Bolus insulin acB and acL
    (eg. 10 u NPH qAM, 5 NR acB, 8 NR acL)
  - Metformin 1g BID, repaglinide acB and acS
    (dose acL >> acB)

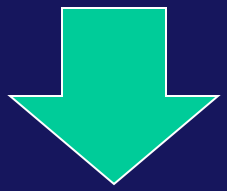
James (cont'd)

Unfortunately, his renal function fails to improve and he ends up requiring chronic dialysis treatment …

How will affect his insulin requirements and glycemic control?

Considerations in renal failure

- Limitations of therapies
- Reduced clearance of insulin
- Reduced renal gluconeogenesis
- Altered eating habits



INCREASED HYPOGLYCEMIA

Park J et al. Curr Diab Rep 2012;12:432-39.

“Burnt-out Diabetes”

Park J et al. Curr Diab Rep 2012;12:432-39.

Mabel

- 72 yo woman in LTC
- Right hemispheric stroke – able to eat and ambulate with walker
- Type 2 DM x 6 years
- Metformin 500 mg BID
- Premixed analogue 30 units BID
- A1c 8.9%, Cr 145 (eGFR 28 mL/min)

Mabel

	Breakfast		Lunch		Supper			
	Before	After	Before	After	Before	After	Bedtime	
Sunday	10.2				9.5		10.5	
Monday	9.8				10.7		8.9	
Tuesday	9.0		12.5		9.9		10.3	
Wednesday	10.5		9.7				9.5	
Thursday	8.8							

What should be done?

- Stop the metformin
- Adjust her insulin


30
27
28
29
30
28
29
30
5
10

Mabel

- Pneumonia
- Premixed analogue 40 units ac breakfast and 35 units ac supper
- Blood sugars “teens”

Mrs. Ma (pneumonia)

1. Add supplemental scale insulin
2. Increase usual dose of insulin
3. Keep same dose of insulin
4. Change to another insulin
5. 1+2

Non-hospital: sick + eating

- Increase testing frequency
- Increase overall insulin doses
- Consider a correction scale if patient is comfortable with it

Non-hospital: sick + not eating

- Increase testing frequency
- Decrease insulin doses routinely
- If on basal-bolus → just give basal
- If on premixed → reduce dose
- If on basal alone → hold secretagogue and decrease basal

- Use a correction scale of bolus analogue if patient is comfortable with it

1. Increase premixed analogue to 48 units ac breakfast and 40 units ac supper
2. Increase capillary glucose testing at least 1-2 x day for safety purposes
3. Supplemental bolus analogue ac meals only:

Blood sugar	Insulin
< 4.0	call MD
4.1-10	NO extra insulin
10.1-13	4 units
13.1-16	6 units
16.1-19	8 units
> 19.0	call MD

Don’t forget other meds to hold/stop when dehydrated

Counsel all Patients About

Sick Day Medication List

2013

Instructions for Healthcare Professionals:
If patients become ill and are unable to maintain adequate fluid intake, or have an acute decline in renal function (e.g. due to gastrointestinal upset or dehydration), they should be instructed to hold medications which will:

A) Increase risk for a decline in kidney function:
- Angiotensin-converting enzyme inhibitor
- Angiotensin receptor blockers
- Direct renin inhibitors
- Non-steroidal anti-inflammatory drugs
- Diuretics

B) Have reduced clearance and increase risk for adverse effects:
- Metformin
- Sulfonylureas (gliclazide, glimepiride, glyburide)

S sulfonylureas
A ACE-inhibitors
D diuretics, direct renin inhibitors

M metformin
A angiotensin receptor blockers
N non-steroidal anti-inflammatory

Please complete the following card and give it to your patient.

Patients should be instructed that increased frequency of self blood glucose monitoring will be required and adjustments to their doses of insulin or oral antihyperglycemic agents may be necessary.

Instructions for Patients
When you are ill, particularly if you become dehydrated (e.g. vomiting or diarrhea), some medicines could cause your kidney function to worsen or result in side effects.

If you become sick and are unable to drink enough fluid to keep hydrated, you should **STOP** the following medications:

- Blood pressure pills
- Water pills
- Metformin
- Diabetes pills
- Pain medications
- Non-steroidal anti-inflammatory drugs (see below)

_____

_____

_____

_____

_____

Please be careful not to take non-steroidal anti-inflammatory drugs (which are commonly found in pain medications (e.g. Advil) and cold remedies).

Please check with your pharmacist before using over-the-counter medications and discuss all changes in medication with your healthcare professional.

Please increase the number of times you check your blood glucose levels. If they run too high or too low, contact your healthcare professional.

If you have any problems, you can call:

_____

How can I remember the insulins??

CHOOSE AN INSULIN TYPE

CHOOSE A BRAND

DOSING

SEE REVERSE FOR TIPS

column.

Prescriber

Address:

Tel:

Patient's Name:

Address:

Tel:

STEP 1: Choose Insulin Type				STEP 2: Dosing and Titration
BASAL **Long-acting analogues** (Clear)		☐ Levemir® ☐ Cartridge ☐ FlexTouch® (prefilled)	☐ Lantus® ☐ Cartridge ☐ Vial ☐ SoloSTAR® (prefilled)	**Starting dose:** _____ units at bedtime Increase dose by _____ units every night until fasting blood glucose has reached the patient's individual target of _____ mmol/L.
Intermediate-acting (Cloudy)	☐ Humulin® N ☐ Cartridge ☐ Vial ☐ Kwikpen™ (prefilled)	☐ Novolin® ge NPH ☐ Cartridge ☐ Vial		
PRANDIAL (BOLUS) **Rapid-acting analogues** (Clear) Give 0-10 minutes before meal.	☐ Humalog® ☐ Cartridge ☐ Vial ☐ Kwikpen™ (prefilled)	☐ NovoRapid® ☐ Cartridge ☐ Vial ☐ FlexTouch® (prefilled)	☐ Apidra® ☐ Cartridge ☐ Vial ☐ SoloSTAR® (prefilled)	**Starting dose:** _____ units ac breakfast _____ units ac lunch _____ units ac supper
Short-acting (Clear) Give 30 minutes before meal.	☐ Humulin® R ☐ Cartridge ☐ Vial	☐ Novolin® ge Toronto ☐ Cartridge ☐ Vial		
PREMIXED **Premixed analogues** (Cloudy) Give 0-10 minutes before meal.	☐ Humalog® Mix25™ ☐ Cartridge ☐ Kwikpen™ (prefilled) ☐ Humalog® Mix50™ ☐ Cartridge ☐ Kwikpen™ (prefilled)	☐ NovoMix® 30 ☐ Cartridge		**Starting doses:** _____ units ac breakfast _____ units ac supper Increase breakfast dose by _____ units every day until pre-supper blood glucose has reached the target of _____ mmol/L. Increase pre-supper dose by _____ units every day until fasting blood glucose has reached the target of _____ mmol/L. Beware of hypoglycemia post-breakfast or post-supper. Stop increasing dose if hypoglycemia occurs.
Premixed regular (Cloudy) Give 30 minutes before meal.	☐ Humulin® 30/70 ☐ Cartridge	☐ Novolin® ge 30/70 ☐ Cartridge ☐ Vial		
PEN DEVICE Required if insulin cartridges selected. Insulin pen should match the insulin brand.	☐ HumaPen® Savvio™ ☐ HumaPen LUXURA® HD ☐ HumaPen® MEMOIR™	☐ NovoPen® 4 ☐ NovoPen Echo®	☐ ClikSTAR®	
OTHER SUPPLIES	☐ Pen needles (if using a pen): Check needle size (refer to back for information): ☐ 4mm ☐ 5mm ☐ 6mm ☐ 8mm OR ☐ At discretion of pharmacist ☐ Glucose test strips ☐ Lancets ☐ Insulin Syringe (if using vials)			
QUANTITY and REPEATS	**Insulin** Mitte: _____ boxes Repeats x _____		**Supplies** Mitte: _____ boxes Repeats x _____	

SELECT PEN DEVICE

CHECK OFF SUPPLIES

QUANTITY & REPEATS

Signature: Date:

Print Name: License #:

SIGN AND DATE

Insulin Initiation and Titration Suggestions for Type 2 Diabetes

People starting insulin should be counseled about the prevention, recognition and treatment of hypoglycemia.

The following are suggestions for insulin initiation and titration. Clinical judgment must always be used as the suggestions may not apply to every patient.

Basal Insulin (only) as an add-on to Antihyperglycemic Agents (Lantus®, Levemir®, Humulin® N, Novolin® ge NPH)

- Target fasting blood glucose (BG) of 4-7 mmol/L.
- Most patients will need 40-50 units at bedtime to achieve target but there is no maximum dose.
- Start at a low dose of 10 units at bedtime (may start at lower dose [0.1-0.2 units/kg] for lean patients [< 50 kg]).
- Patient should gently self-titrate by increasing the dose by 1 unit every 1 night until fasting BG target of 4-7 mmol/L is achieved.
- If fasting hypoglycemia occurs, the dose of bedtime basal should be reduced.
- Metformin and the secretagogue are usually maintained when basal insulin is added.
- If daytime hypoglycemia occurs, reduce the oral antihyperglycemic agents (especially secretagogues).
- Lantus® or Levemir® can be given at bedtime or in the morning.

Dosing and Titration

Starting dose 10 units at bedtime.

Increase dose by 1 unit every 1 night until fasting blood glucose has reached the target of 4-7 mmol/L (usual target).

Basal + Bolus Insulins

- When basal insulin added
  meals. The regimens below
  postprandial BG as a starti
- Typically, insulin secretago
- For current basal insulin us
  example, if the patient is c
- For new insulin users start
  - 40% of TDI dose as basa
  - 20% of TDI dose as prandial (bolus) insulin prior to each meal.
  - Rapid-acting insulin analogues (Apidra®, Humalog®, NovoRapid®) should be given 0-10 minutes before eating.
  - Short-acting insulin (Humulin® R, Novolin® ge Toronto) should be given 30 minutes before eating.
- An alternative distribution is 50% basal insulin (at bedtime) and 50% bolus insulin (distributed among the meals of the day).
- Adjust the dose of the basal insulin to achieve the target fasting BG level (usually 4-7 mmol/L).
- Adjust the dose of the bolus (prandial) insulin to achieve postprandial BG levels (usually 5-10 mmol/L) or pre-prandial BG levels for the subsequent meal (usually 4-7 mmol/L).

ng Example (100kg person)

ily Insulin = 0.5 units/kg:
0kg (TDI)
= 50 units

sulin = 40% of TDI:
0 units
l bedtime = 20 units

Bolus Insulin = 60% of TDI:
60% x 50 units
- Bolus = 30 units

= 10 units with each meal

Premixed Insulin Before Breakfast and Before Dinner (Humalog® Mix25™, Humalog® Mix50™, NovoMix® 30, Humulin® 30/70, Novolin®ge 30/70)

- Target fasting and pre-supper BG levels of 4-7 mmol/L.
- Most patients with type 2 diabetes will need 40-50 units twice a day to achieve target but there is no maximum dose.
- Start at a low dose of 5 to 10 units twice daily (before breakfast and before supper).
- Patient can gently self-titrate by increasing the breakfast dose by 1 unit every day until the pre-supper BG is at target.
- Patient can gently self-titrate by increasing the supper dose by 1 unit every day until the fasting BG target is at target.
- Beware of hypoglycemia post-breakfast or post-supper. Stop increasing dose if this occurs.
- Premixed analogue insulins (Humalog® Mix25™, Humalog® Mix50™, NovoMix® 30) should be given 0 to 10 minutes before eating.
- Premixed regular insulins (Humulin® 30/70, Novolin® ge 30/70) should be given 30 minutes before eating.
- Continue Metformin and consider stopping secretagogue.

Dosing and Titration

10 units ac breakfast , 10 units ac supper.

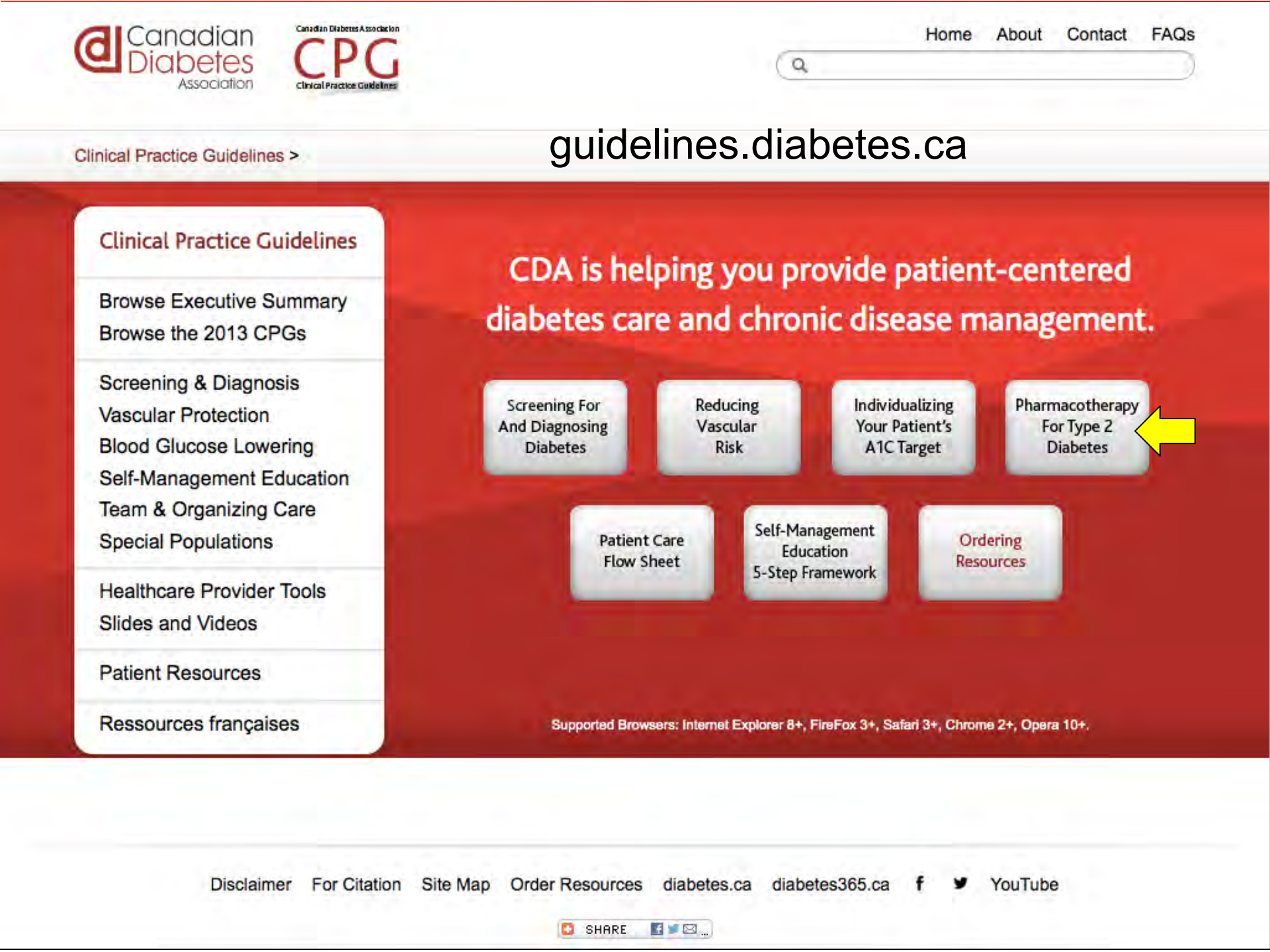
Increase breakfast dose by 1 unit every 1 day until pre-supper blood glucose has reached the target of 4-7 mmol/L (usual target).

Increase supper dose by 1 unit every 1 day until fasting blood glucose has reached the target of 4-7 mmol/L (usual target).

Selection of Pen Needle

- Forum for Injection Technique (FIT) Canada recommends that 4, 5, and 6mm needles are suitable for all people with diabetes regardless of BMI. In addition, there is no clinical reason for recommending needles longer than 8mm. Initial insulin therapy should start with the shorter needle length (Berard L, et al. FIT Forum for Injection Technique Canada. Recommendations for Best Practice in Injection Technique. October 2011).

How can I remember the med choices in renal failure or other comorbidities?


Canadian Diabetes Association
Canadian Diabetes Association CPG Clinical Practice Guidelines
Home About Contact FAQs
Clinical Practice Guidelines >
guidelines.diabetes.ca
Clinical Practice Guidelines
Browse Executive Summary
Browse the 2013 CPGs
Screening & Diagnosis
Vascular Protection
Blood Glucose Lowering
Self-Management Education
Team & Organizing Care
Special Populations
Healthcare Provider Tools
Slides and Videos
Patient Resources
Ressources françaises
CDA is helping you provide patient-centered diabetes care and chronic disease management.
Screening For And Diagnosing Diabetes
Reducing Vascular Risk
Individualizing Your Patient's A1C Target
Pharmacotherapy For Type 2 Diabetes
Patient Care Flow Sheet
Self-Management Education 5-Step Framework
Ordering Resources
Supported Browsers: Internet Explorer 8+, FireFox 3+, Safari 3+, Chrome 2+, Opera 10+.
Disclaimer For Citation Site Map Order Resources diabetes.ca diabetes365.ca YouTube
SHARE

Pharmacotherapy for Type 2 Diabetes

By Agent and Patient Characteristics

At diagnosis of type 2 diabetes:
Start lifestyle intervention (nutrition therapy and physical activity)
+/- Meformin

Which of the following applies to your patient?

- A1C <8.5%
- A1C ≥8.5%
- Symptomatic hyperglycaemia with metabolic decompensation

Get Recommendation

This is only to be used as a decision support tool and is subject to these terms.
For more information, please see the disclaimer.

Recommendations:

Start metformin immediately. Consider initial combination with another antihyperglycemic agent.

If the glycemic target is still not reached, add an agent best suited to the individual. See the following table. **Click a column title** to sort the table by that column.

Individualize the table based on patient characteristics:

Does your patient have Congestive Heart Failure? ○ Yes ◉ No

Does your patient have metabolic bone disease? ○ Yes ◉ No

Does your patient currently have pancreatitis? ○ Yes ◉ No

Does your patient have a prior history of pancreatitis? ○ Yes ◉ No

What is your patients renal function (eGFR in mL/min/1.73m^2)? [ ]

Individualize

Class ▲	Relative A1C lowering	Hypoglycemia	Weight	Cost	Other therapeutic considerations
Alpha-glucosidase inhibitor (acarbose)	↓	Rare	neutral to ↓	$$	Improved postptandial control, GI side-effects
Incretin agent: DPP-4 Inhibitors	↓ ↓	Rare	neutral to ↓	$$$	
Incretin agent: GLP-1 receptor agonists	↓ ↓ to ↓ ↓ ↓	Rare	↓ ↓	$$$$	GI side-effects
Insulin	↓ ↓ ↓	Yes	↑ ↑	$ $$$$	No dose ceiling, flexible regimens

Individualize

Class ▲	Relative A1C lowering	Hypoglycemia	Weight	Cost	Other therapeutic considerations
Alpha-glucosidase inhibitor (acarbose)	↓	Rare	neutral to ↓	$$	Improved postptandial control, GI side-effects
Incretin agent: DPP-4 Inhibitors	↓↓	Rare	neutral to ↓	$$$	
Incretin agent: GLP-1 receptor agonists	↓↓ to ↓↓↓	Rare	↓↓	$$$$	GI side-effects
Insulin	↓↓↓	Yes	↑↑	$-$$$$	No dose ceiling, flexible regiments
Insulin secretagogue: Meglitinide	↓↓	Yes	↑	$$	Less hypoglycemia in context of missed meals but usually requires TID to QID dosing
Insulin secretagogue: Sulfonylurea	↓↓	Yes	↑	$	Gliclazide and glimepiride associated with less hypoglycemia than glyburide
TZD	↓↓	Rare	↑↑	$$	CHF, edema, fractures, rare bladder cancer (pioglitazone), cardiovascular controversy (rosiglitazone), 6-12 weeks required for maximal effect
Weight loss agent (orlistat)	↓	None	↓	$$$	GI side effects

*When sorting table by column, rows with equivalent values are sorted alphabetically. Therefore, the **row order of equivalent values does not imply a preference**.*

Click on column heading to prioritize the table based on that parameter

Individualize

Class	Relative A1C lowering ▼	Hypoglycemia	Weight	Cost	Other therapeutic considerations
Insulin	↓↓↓	Yes	↑↑	$-$$$$	No dose ceiling, flexible regiments
Incretin agent: GLP-1 receptor agonists	↓↓ to ↓↓↓	Rare	↓↓	$$$$	GI side-effects
TZD	↓↓	Rare	↑↑	$$	CHF, edema, fractures, rare bladder cancer (pioglitazone), cardiovascular controversy (rosiglitazone), 6-12 weeks required for maximal effect
Insulin secretagogue: Sulfonylurea	↓↓	Yes	↑	$	Gliclazide and glimepiride associated with less hypoglycemia than glyburide
Insulin secretagogue: Meglitinide	↓↓	Yes	↑	$$	Less hypoglycemia in context of missed meals but usually requires TID to QID dosing
Incretin agent: DPP-4 Inhibitors	↓↓	Rare	neutral to ↓	$$$	
Weight loss agent (orlistat)	↓	None	↓	$$$	GI side effects
Alpha-glucosidase inhibitor (acarbose)	↓	Rare	neutral to ↓	$$	Improved postptandial control, GI side-effects

*When sorting table by column, rows with equivalent values are sorted alphabetically. Therefore, the **row order of equivalent values does not imply a preference**.*

sources françaises

Further individualize the table by answering questions

Recommendations:

Start metformin immediately. Consider initial combination with another antihyperglycemic agent.

If the glycemic target is still not reached, add an agent best suited to the individual. See the following table. **Click a column title** to sort the table by that column.

Individualize the table based on patient characteristics:

Does your patient have Congestive Heart Failure? ○ Yes ◉ No

Does your patient have metabolic bone disease? ○ Yes ◉ No

Does your patient currently have pancreatitis? ○ Yes ◉ No

Does your patient have a prior history of pancreatitis? ○ Yes ◉ No

What is your patients renal function (eGFR in mL/min/1.73m^2)? 24

Add in eGFR

Individualize

Class	Relative A1C lowering ▼	Hypoglycemia	Weight	Cost	Other therapeutic considerations
Insulin	↓↓↓	Yes	↑↑	$-$$$$	No dose ceiling, flexible regiments
Incretin agent: GLP-1 receptor agonists	↓↓ to ↓↓↓	Rare	↓↓	$$$$	GI side-effects
TZD	↓↓	Rare	↑↑	$$	CHF, edema, fractures, rare bladder cancer (pioglitazone), cardiovascular controversy (rosiglitazone), 6-12 weeks required for maximal effect

This table has been individualized and some medications have been removed based on patient characteristics.

Click reset to remove this setting.

Click a column title to sort results by that column

Class ▲	Relative A1C lowering	Hypoglycemia	Weight	Cost	Other therapeutic considerations
Incretin agent: DPP-4 Inhibitors	↓ ↓	Rare	neutral to ↓	$$$	Reduced dose for saxagliptin and sitagliptin. No change for linagliptin.
Insulin	↓ ↓ ↓	Yes	↑ ↑	$-$$$$	No dose ceiling, flexible regiments
Insulin secretagogue: Meglitinide	↓ ↓	Yes	↑	$$	Less hypoglycemia in context of missed meals but usually requires TID to QID dosing
Insulin secretagogue: Sulfonylurea	↓ ↓	Yes	↑	$	Caution/reduced dose gliclazide & glimepiride, glyburide not recommended
TZD	↓ ↓	Rare	↑ ↑	$$	Caution/reduced dose
Weight loss agent (orlistat)	↓	None	↓	$$$	GI side effects

Table has changed to match the needs of the patient based on characteristics and eGFR

*When sorting table by column, rows with equivalent values are sorted alphabetically. Therefore, the **row order of equivalent values does not imply a preference**.*

Caution: eliminate metformin from treatment plan.

Caution: Acarbose eliminated from treatment plan because of renal failure.

Caution: GLP-1 receptor agonists eliminated from treatment plan because of reduced eGFR.

Summary

- Diabetes is PROGRESSIVE
- Regimens need to CHANGE over time
- Understand the time-action profiles to tailor the regimen and dosage to the patient's needs

Summary

- Shift worker - DO NOT use premixed regimen
- Renal dysfunction
  - Limitations with non-insulin antihyperglycemic agents
  - Need to modify as per dialysis schedule
  - May need lower doses of insulin until dialysis

Summary

- Acutely ill patient
  - DO NOT use sliding scale only
  - Think Basal + Bolus + Correction regimen
  - Think increase usual dose + Correction
- NPO patient: Basal only (SC or IV)
- Enteral feeds: Basal only (if continuous)
- Glucocorticoids: Remember steroid pattern

References

1. 2013 Canadian Diabetes Association clinical practice guidelines. Can J Diab 2013; in press
2. McMahon GT, Dluhy RG. Intention to treat – initiating insulin and the 4T study. N Engl J Med 2007;357:1759.
3. Leahy JL. In: Leahy JL, Cefalu WT (eds). *Insulin Therapy.* Marcel Dekker Inc., New York, 2002.
4. Bolli GB, Di Marchi RD, Park GD, et al. Insulin analogues and their potential in the management of diabetes mellitus. Diabetologia 1999; 42:1151-67.
5. Raccah D, Bretzel RG, Owens D, Riddle M. When basal insulin therapy in type 2 diabetes mellitus is not enough – what next? Diabetes Metab Res Rev 2007;23:257-64.
6. Harris SB, et al. START protocol. As presented at CDA/CSEM conference in Vancouver, BC, October 2012

References

7. Meneghini L, Mersebach H, Kumar S, et al. Comparison of 2 intensification regimens with rapid-acting insulin aspart in type 2 diabetes mellitus inadequately controlled by once-daily insulin detemir and oral antidiabetes drugs: The Step-Wise randomized study. Endocr Pract 2011;17:727-36.

7. Park J, Lertdumrongluk P, Molnar MZ, et al. Glycemic control in diabetic dialysis patients and the burnt-out diabetes phenomenon. Curr Diab Rep 2012;12:432-9.\

8. Ontario College of Family Physicians Insulin Prescription Tool available at www.ocfp.on.ca