Managing glucose before, during and after exercise

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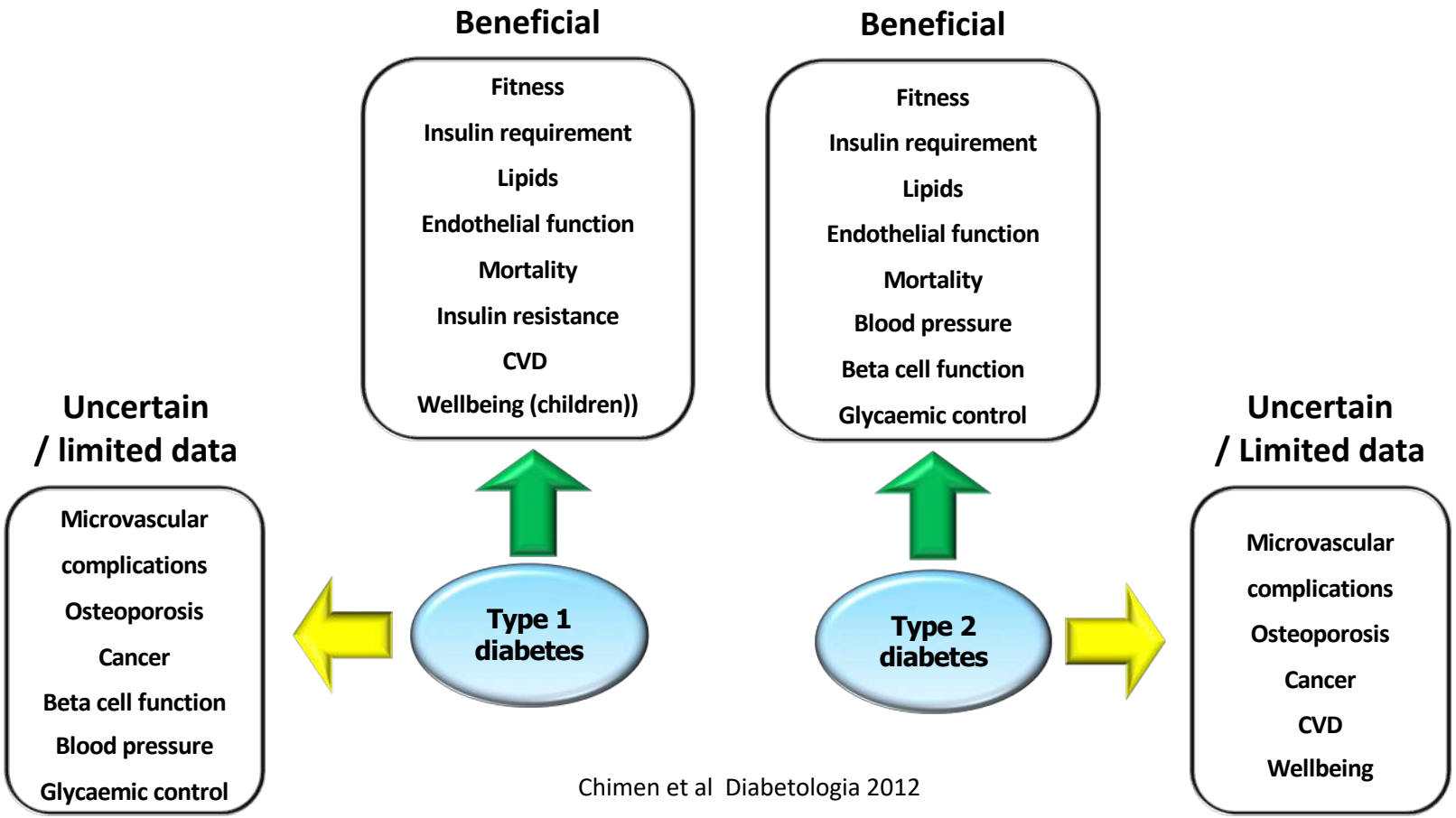
Learning objectives

1. What are the benefits and barriers to exercise in people with T1D
2. what you need to think about before you exercise
3. what options are available for managing glucose during exercise
4. what options are available for managing glucose after exercise

Mainly will concentrate on Type 1 diabetes but will give few tips for Type 2 diabetes

Benefits of exercise



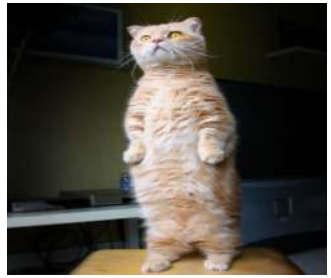
Chimen et al Diabetologia 2012

What are the recommendations?

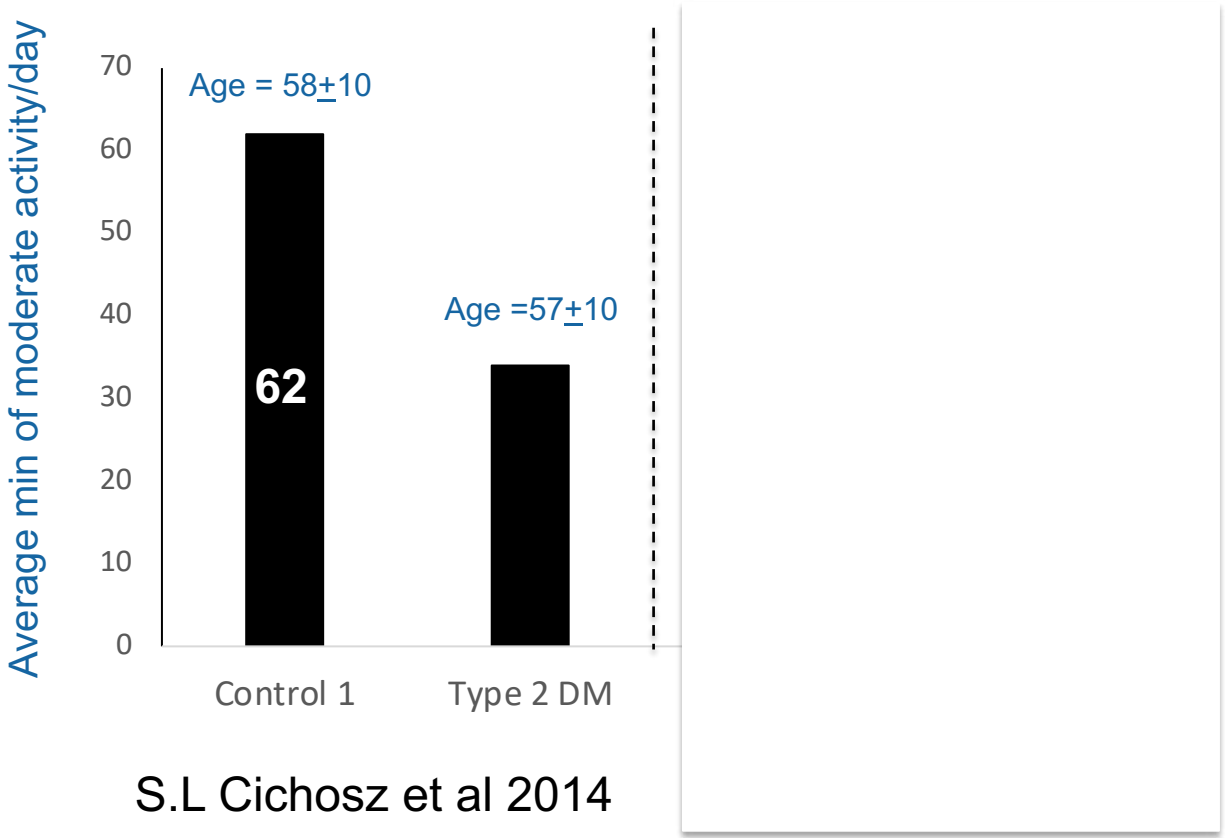
150 minutes per week of moderate to vigorous aerobic activity

Resistance training three times a week

Reduce sitting time – try to get up three times per hour



Activity of Patients with diabetes



S.L Cichosz et al 2014

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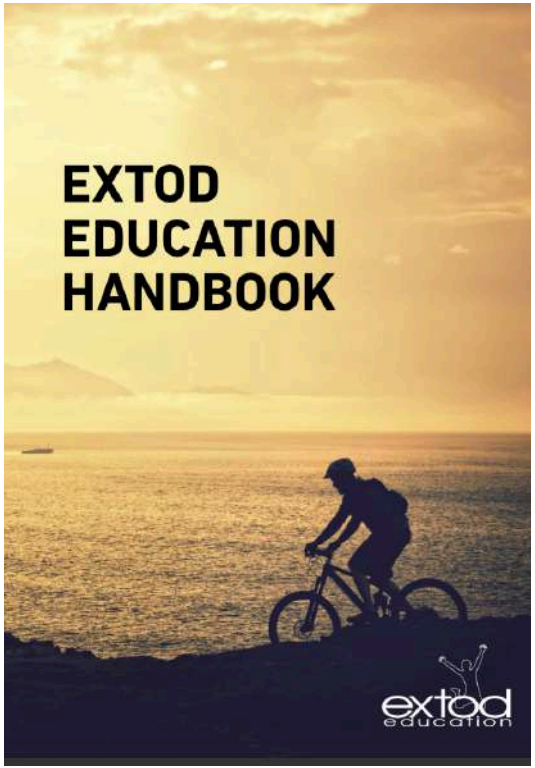

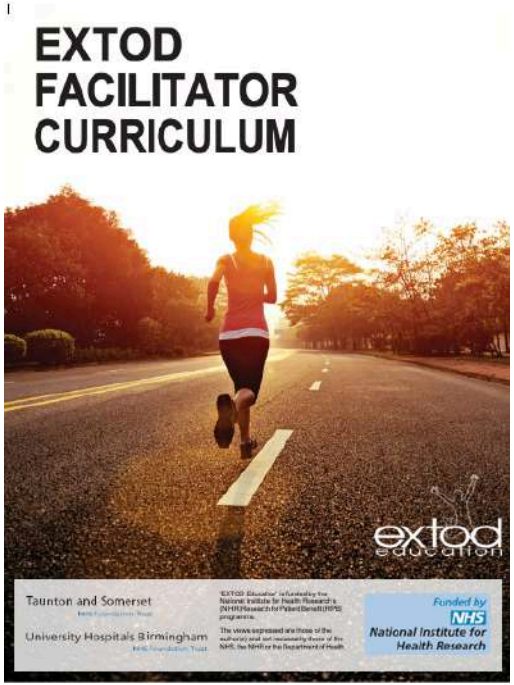

Litchfield 2019
Narendran 2019

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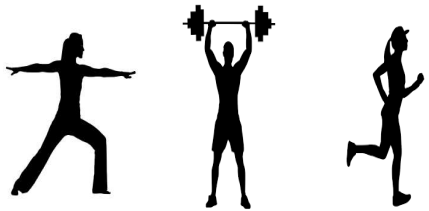
Diabetes treatment and exercise in Type 2 diabetes

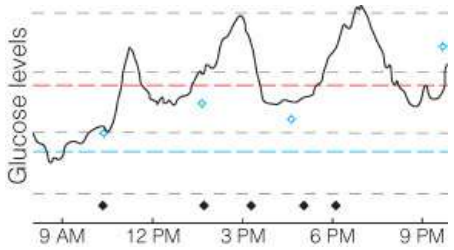
Type of drug	Risk of low blood sugar
Metformin	No risk
Sulphonylureas (Eg.gliclazide)	Low
DPPIV inhibitor (eg. saxagliptin)	Very Low
Rosiglitazone	Very low
GLP-1 (eg. liraglutide, Exenatide)	Very low
SGLT-2 inhibitor (eg. empagliflozin)	Very low
Insulin (insulatard)	Low

Considering exercise – three things to think about



The exercise

Time of day



Glucose level

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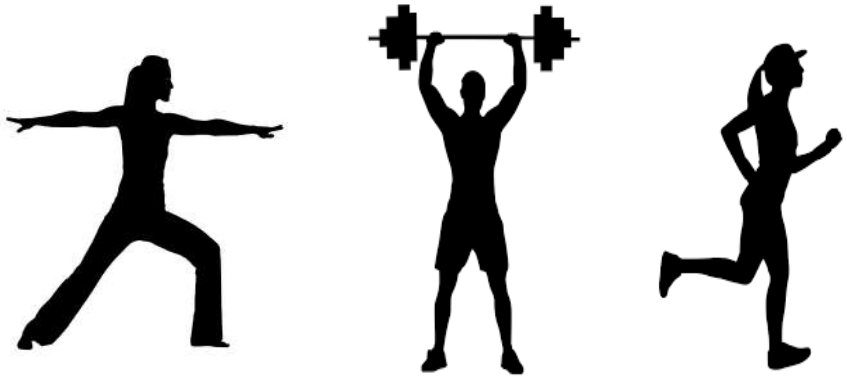
The exercise – three things need to know

- Type of exercise
- Intensity of exercise
- Length of exercise



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Three types of exercise

AEROBIC

Hiking

Golf

Road cycling

Cycle tour

Mountain biking

Distance running

Distance swimming

Marathon

ANAEROBIC

Weight lifting

Body Building

Dressage

Fencing

Track and field events

Sprinting

Archery

Wrestling

FLEXIBILITY

Stretching

Yoga

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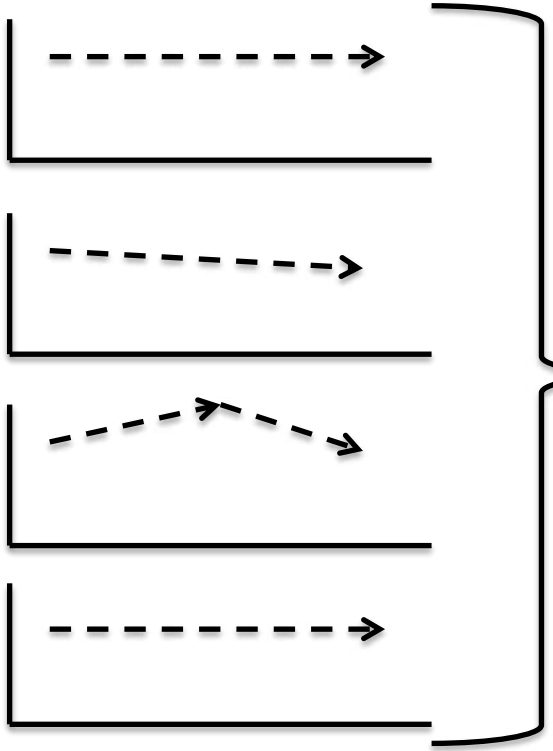
Normal glucose responses to different exercises

Flexibility / Stretching

Aerobic

Anaerobic

Mixed



This is the same in People with T2DM

Initial Blood Glucose Change

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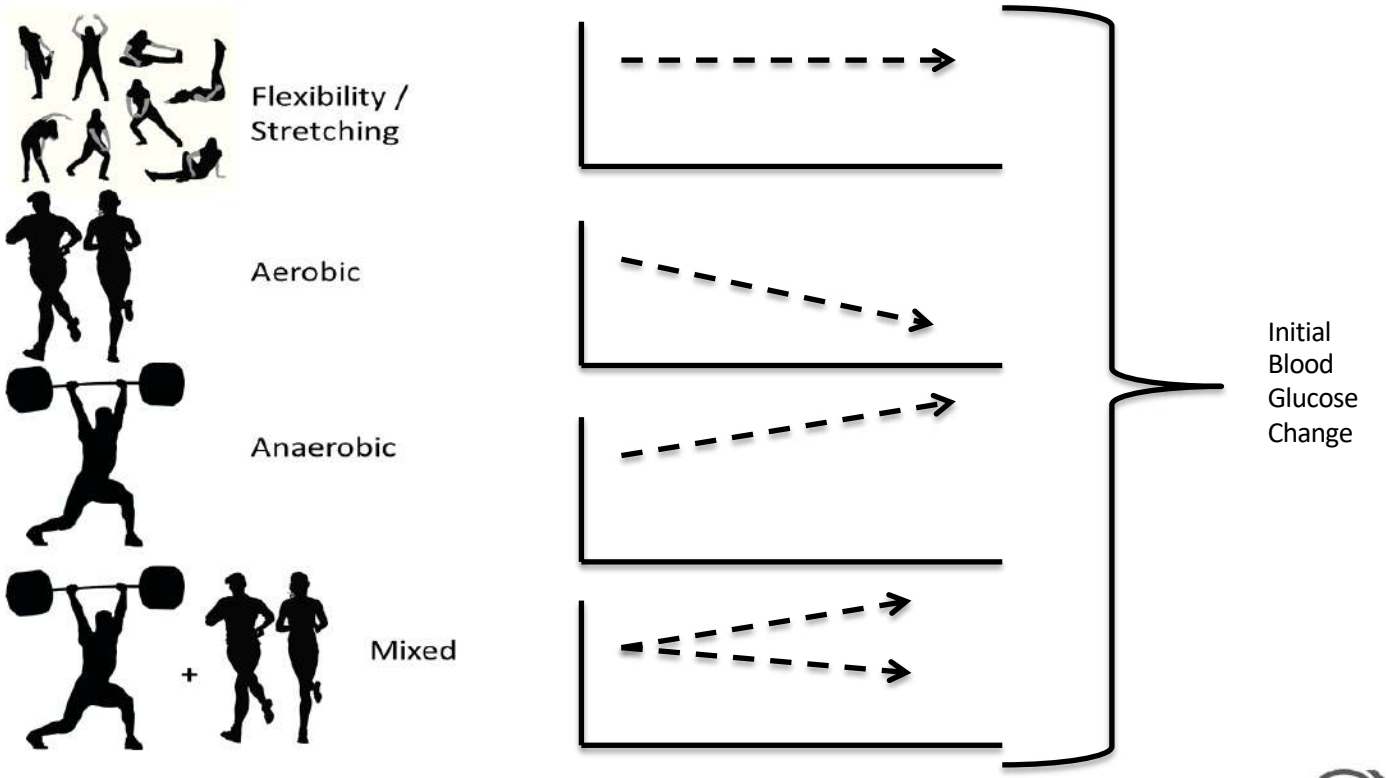
Glucose responses to different exercises in T1D



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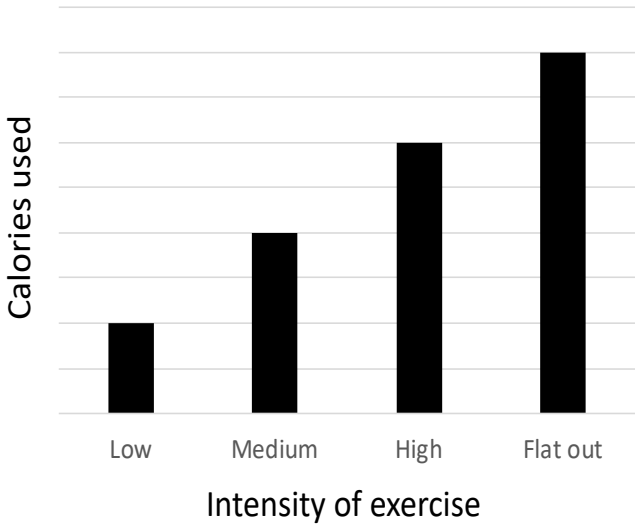
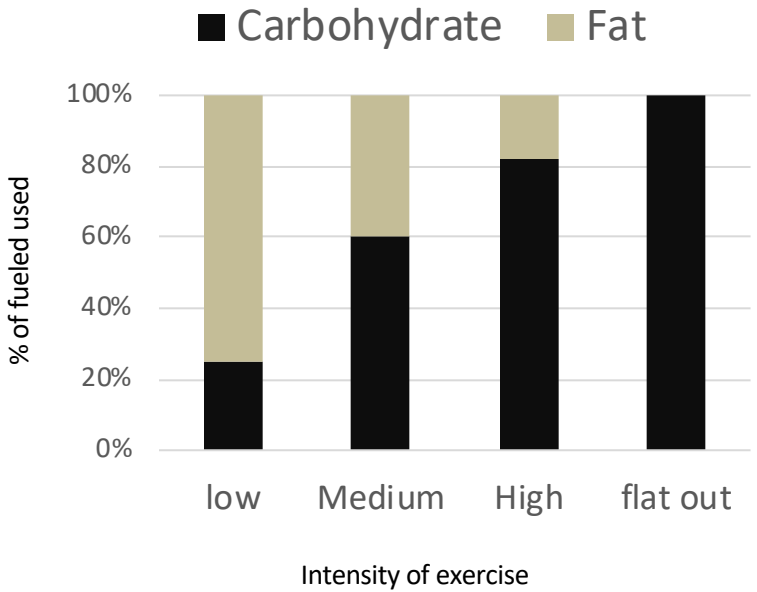
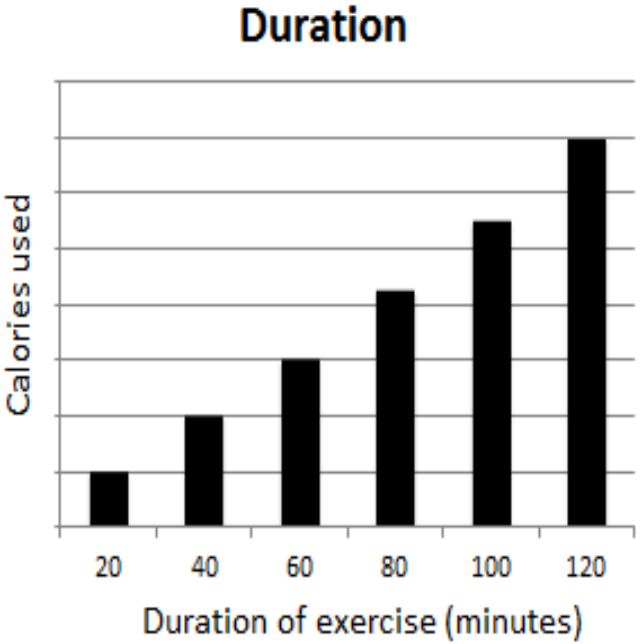
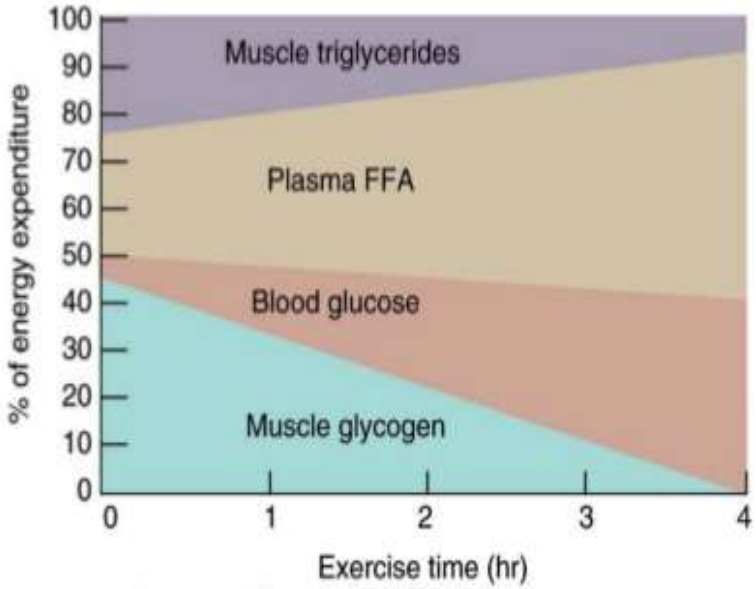
Intensity of exercise





Length of exercise





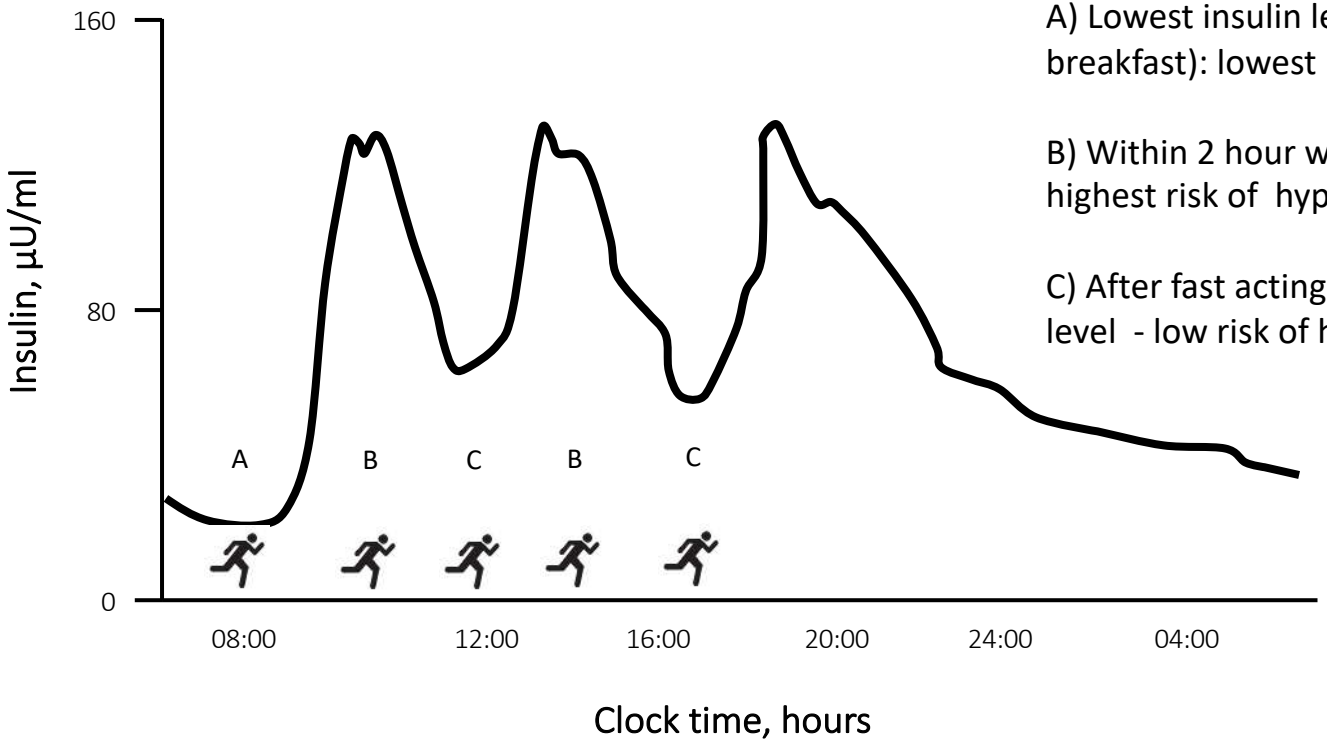
Summary 1

- Type of exercise will effect direction glucose goes in
- Intensity of exercise will determine amount of glucose used
- Length of exercise will determine amount of glucose used

Time of day – three things to think about

- How much insulin do you have on board?
- When did you last eat?
- Are you exercising in the morning or afternoon?

Prevailing insulin levels



A) Lowest insulin level on waking (pre-breakfast): lowest risk of hypoglycaemia here

B) Within 2 hour window of fast acting insulin: highest risk of hypoglycaemia here

C) After fast acting insulin: second lowest insulin level - low risk of hypoglycamia

If type 2 diabetes and on Insulin or sulphonylurea Best to exercise at A or C

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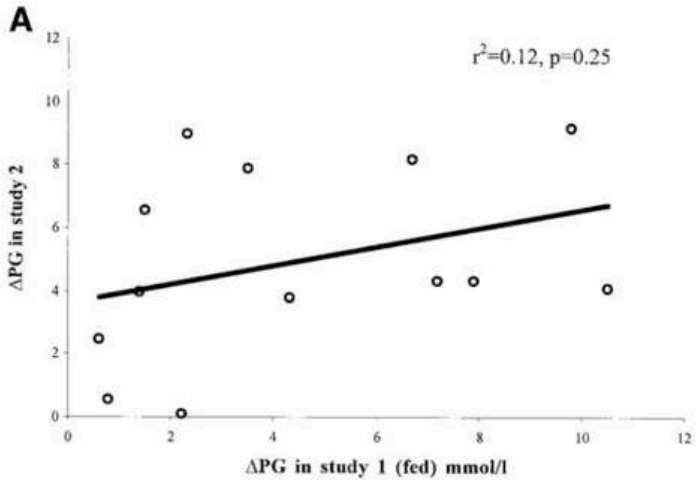
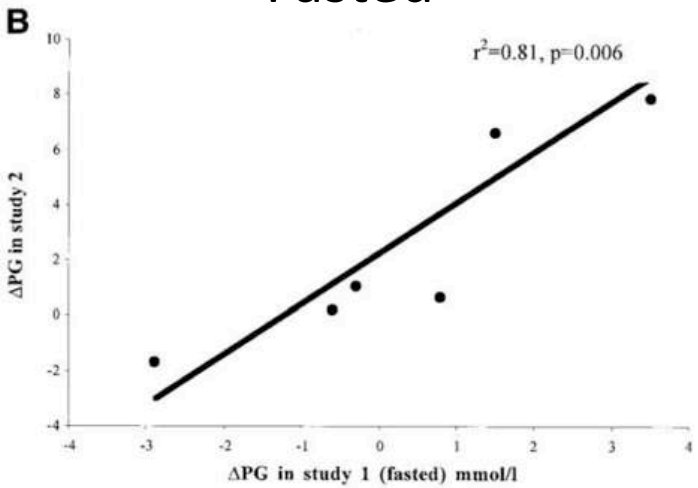
Glucose response to exercise Fed vs fasted

Fed



Poor reproducibility in the blood glucose response to aerobic exercise in individuals with T1D in the post meal state

Fasted



Good reproducibility in the blood glucose response to aerobic exercise in individuals with T1D in the fasted state

Biankin et al., Diabetes Care 2003

Morning or afternoon exercise?

Greater risk of hypo if exercise undertaken after 4pm

Insulin resistance

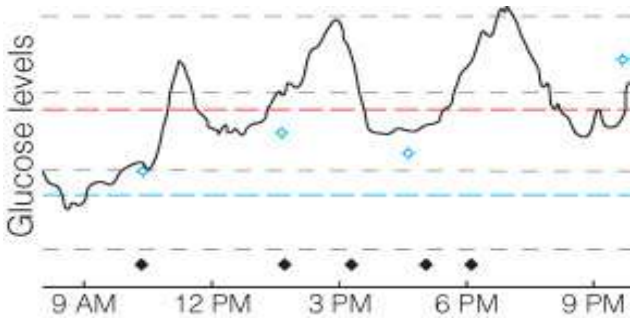
Wakefulness

Summary 2

- Less risk of hypo if exercise when fasted
- Glucose response to exercise is more reliant if exercise fasted
- Higher risk of post exercise hypoglycaemia if exercise later in day

Glucose level– three things to think about

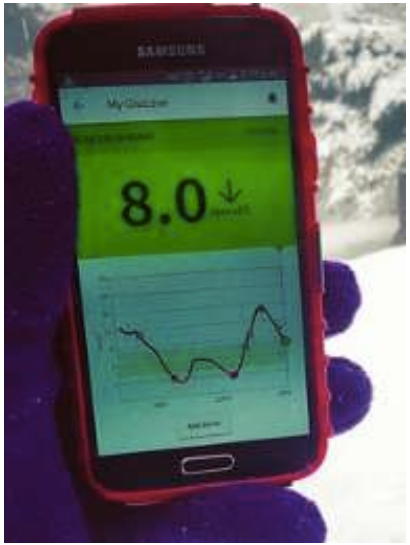
- Have you had a hypo in the last 24 hours?
- What has been happening to your glucose in last hour?
- What is your current blood glucose?



Hypoglycaemia and exercise

Type of hypo	Risk of hypo with exercise
Severe hypoglycaemic episode (needed help from someone else) in last 24 hours.	Risk of hypoglycaemia with exercise and after exercise is very high. **Advice is not to exercise on that day**
Hypoglycaemic episode self treated in last 24 hours.	Higher risk of hypoglycaemia with exercise and after exercise **Advice is to** **1. Not to do lone events/ training** **2. Monitor more frequently** **3. Check blood overnight**

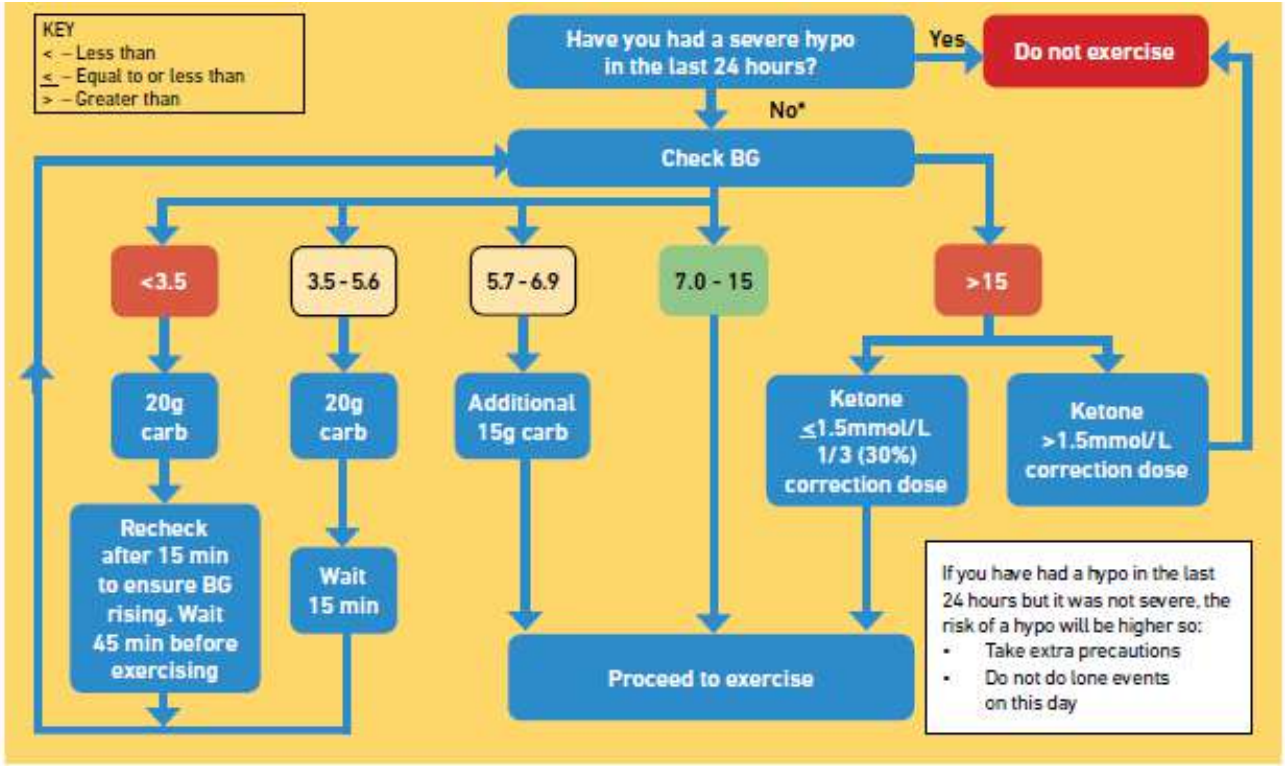
Direction of glucose



Although both have of these show glucoses in target range for exercise, response to exercise is likely to be different

Alternatively,
Check BG twice in the previous half hour

Simple flowchart for glucose and exercise



Addition information for Libre

Confirm with BG reading if

- Glucose <6.0
- Glucose >15

If ⬆ and glucose 5.7-6.9: no need for extra carbs, proceed to exercise. Stick to advice if in any other range

If ⬇ and glucose 5.7-6.9: take twice as much carbs at 20 and 40 minutes into exercise

If ⬇ and glucose 7.0-9.0: take 15 grams of carbs at start of exercise

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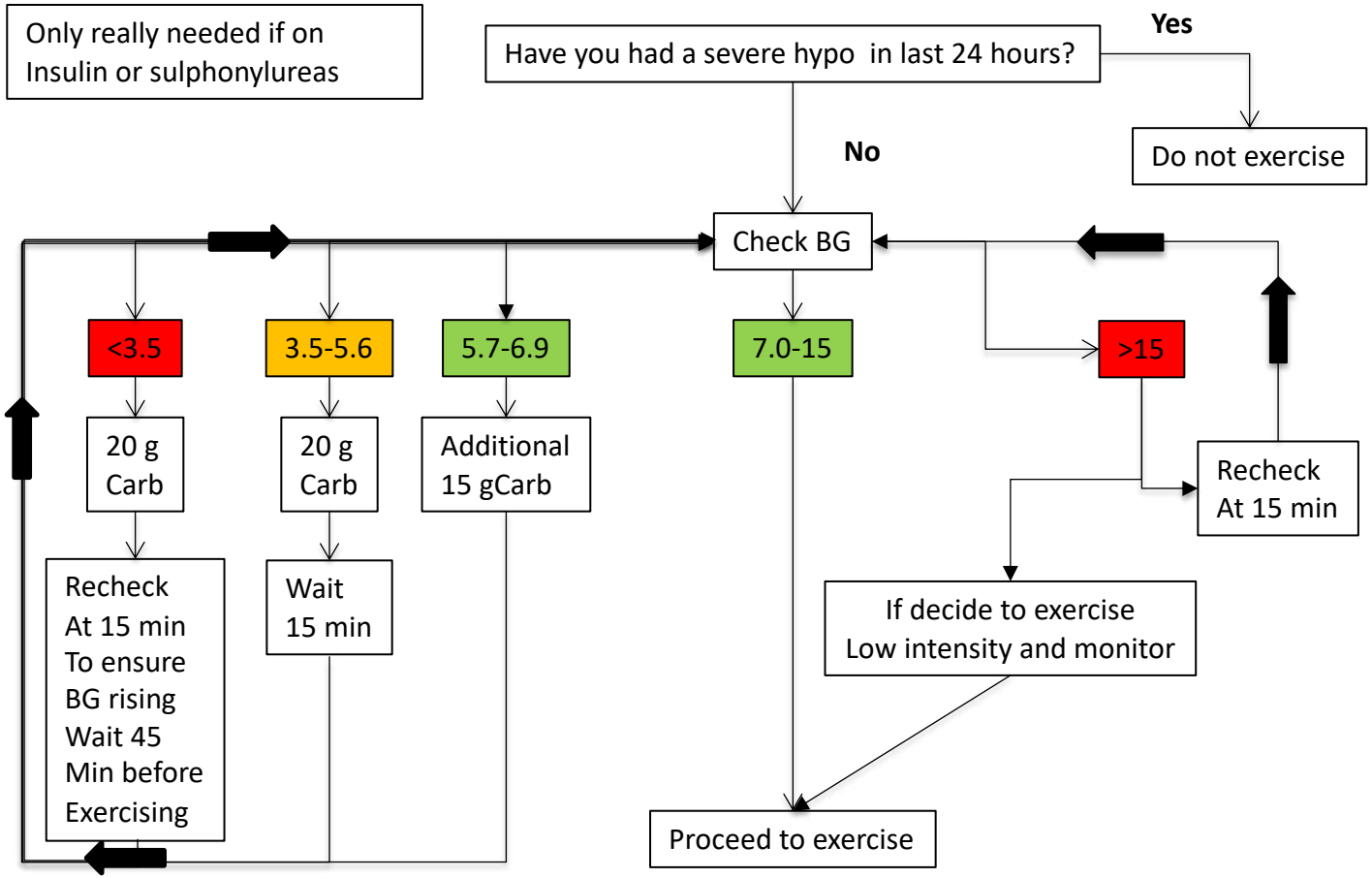
Blood sugars and exercise – type 2 diabetes

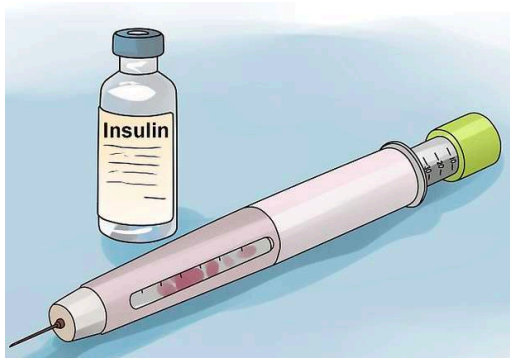


Summary 3

- Glucoses in the last 24 hours are important in determining if someone can exercise and how they should exercise

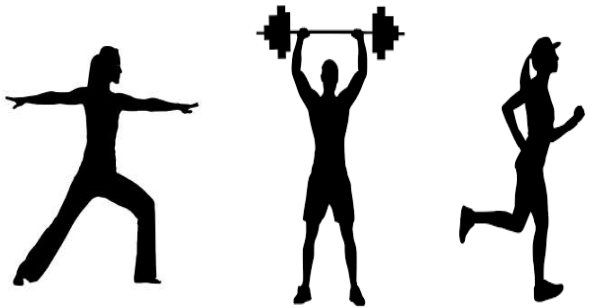
- Blood glucose just before starting to exercise can determine whether safe to exercise and whether action needs to be taken before exercise

Three ways to manage glucose during exercise - ICE



Insulin

Carbohydrate



Exercise

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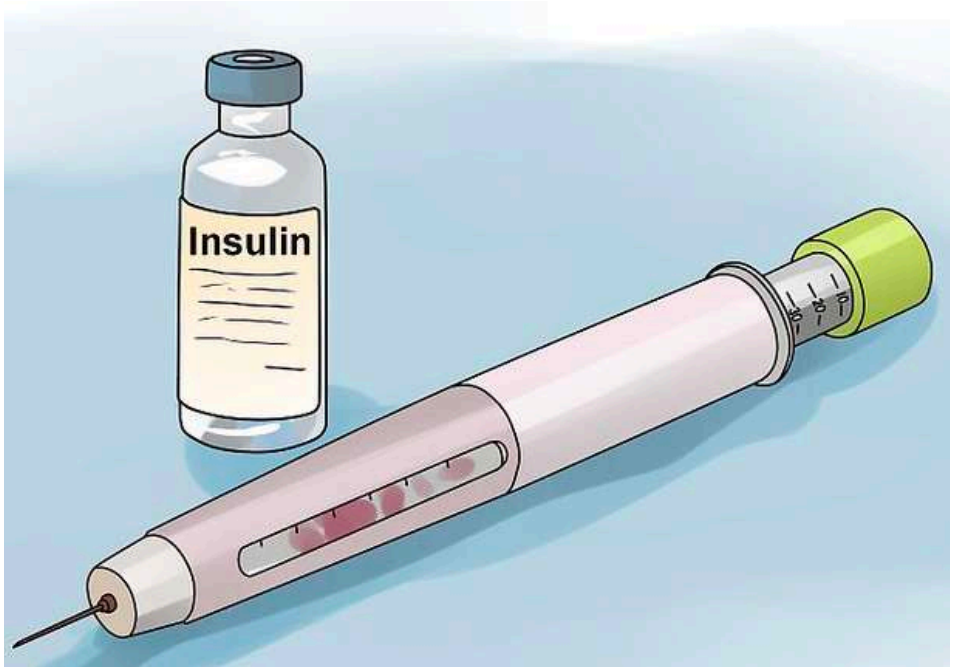
Using insulin to manage glucose during exercise



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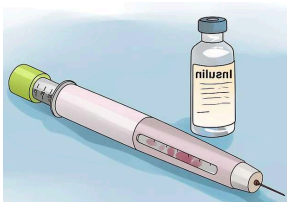
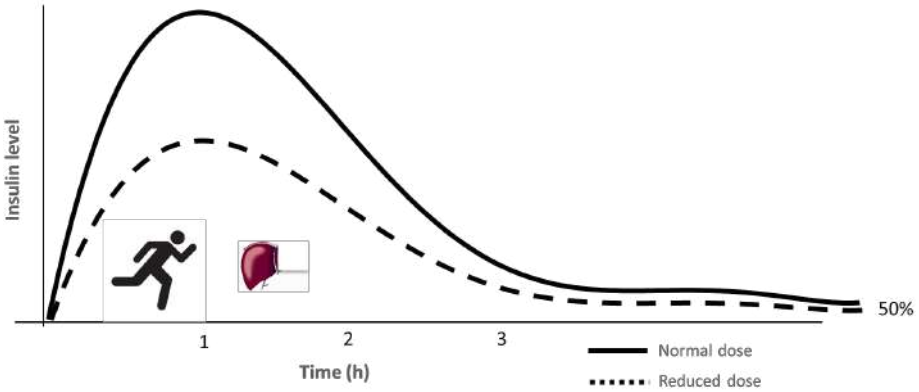
Simple strategy for meal-insulin

If exercising within 2 hours of quick acting (bolus) insulin

- Reduce pre-exercise fast acting (bolus) insulin by 50%





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Simple strategy for basal insulin on pumps

- Reduce basal insulin by 50% one hour before starting exercise
- Return to usual basal rate at the end of exercise

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Using carbohydrate to manage glucose during exercise

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Simple carbohydrate regime

- 30 grams/ hr

Examples of carbohydrates you could try

Carbohydrate source	10 grams	15 grams	30 grams
Jelly Babies (large)	2	3	6
Jelly Beans	6	9	18
Cola	100 ml	150ml (mini can)	300ml
Lucozade Body Fuel Energy Gel	1/3 X 45g tube	½ X 45g tube	1 X 45g tube
Apple Juice	80 ml	120ml	240ml
Lucozade Sport Body Fuel	167 ml	250ml	500ml
Powerade Isotonic	133 ml	200ml	400ml
Gatorade	167 ml	250ml	500ml

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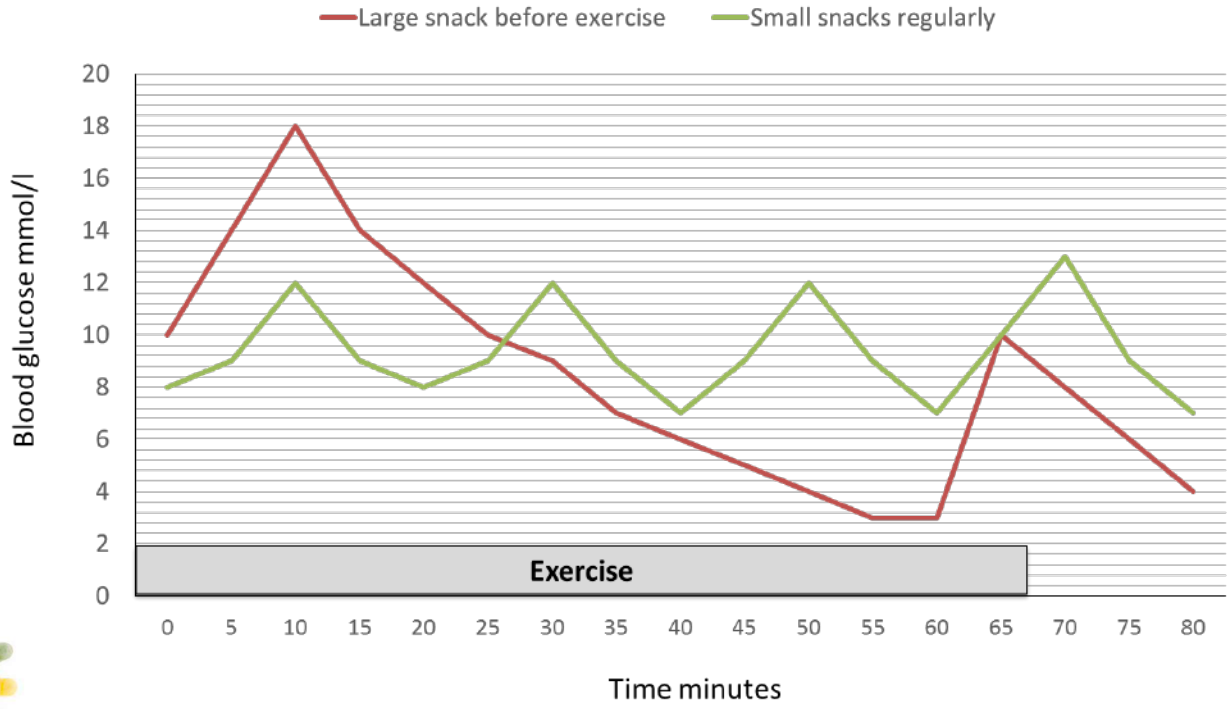
Simple carbohydrate regime

Start with 30g/hour, move onto to 60g/hour or to other strategies



Taking something every 20 minutes will keep blood glucose stable

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Carbohydrate intake during exercise

CGM Glucose level	Trend arrow(s)	Action	Comments
<5.0 mmol/L	None or downward trending	15-20g CHO 	Stop exercise if blood glucose ≤ 3.9 mmol/L
5.0-6.1 mmol/L	↘ Libre	15g CHO 	
5.0-6.1 mmol/L	↓ Libre	20g CHO 	
6.1-6.9 mmol/L	↘ or ↓ Libre	8g CHO 	
>7.0 mmol/l		No action	

Using exercise to manage glucose during exercise

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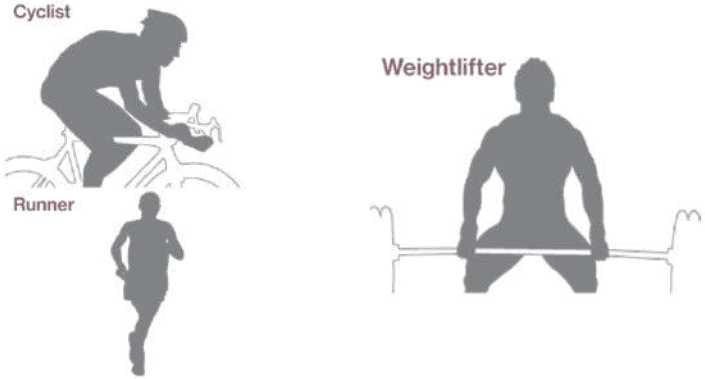
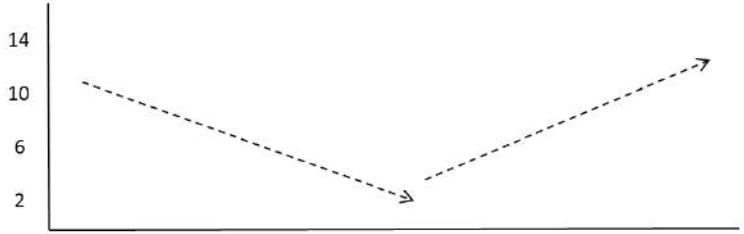
Order of exercise types

Order 1

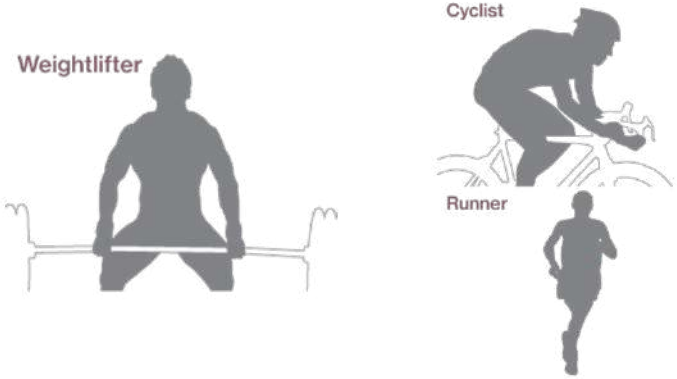
Aerobic then Anaerobic

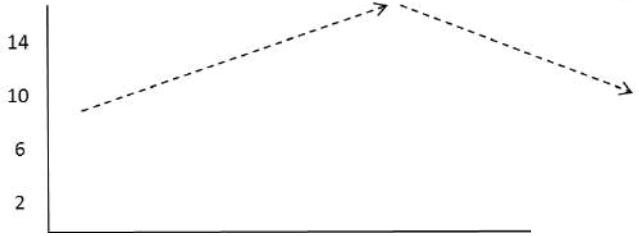




Order 2

Anaerobic then Aerobic





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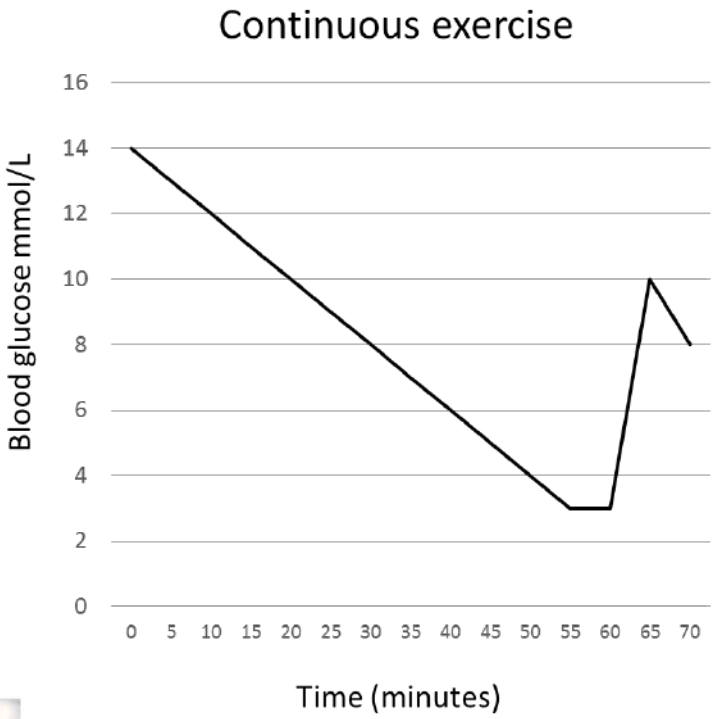
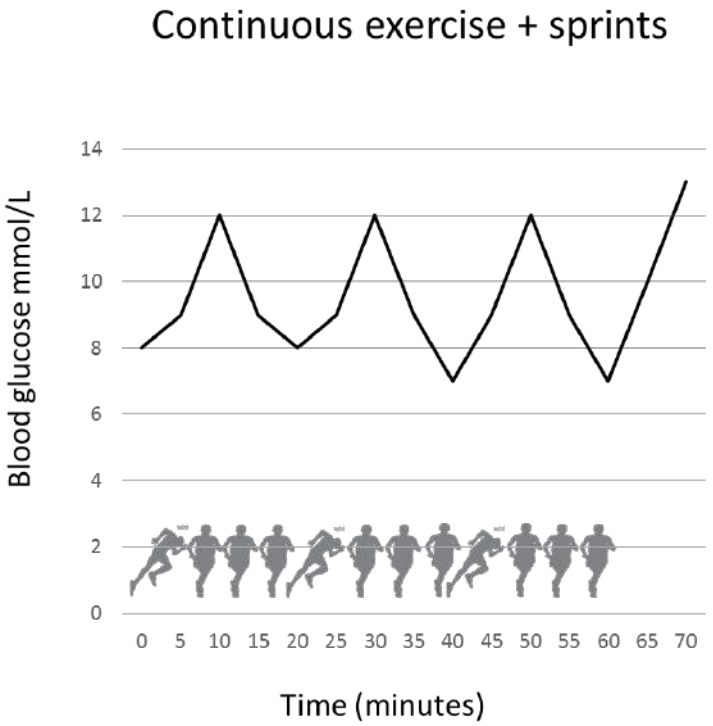
Sprinting increases your glucose





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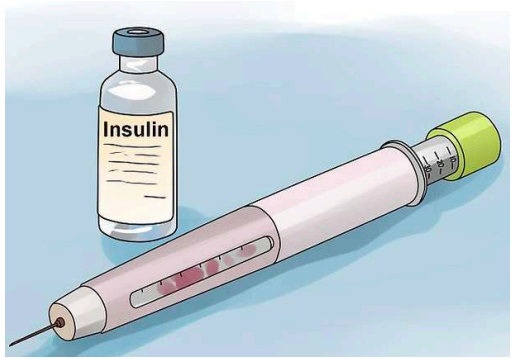
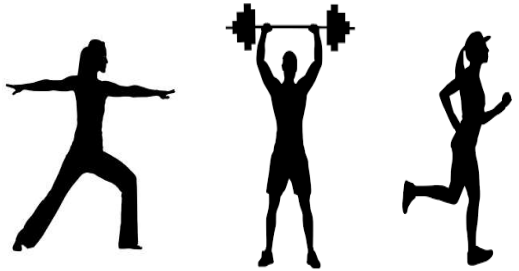
Three ways to manage glucose post exercise - ICE



Insulin

Carbohydrate



Exercise

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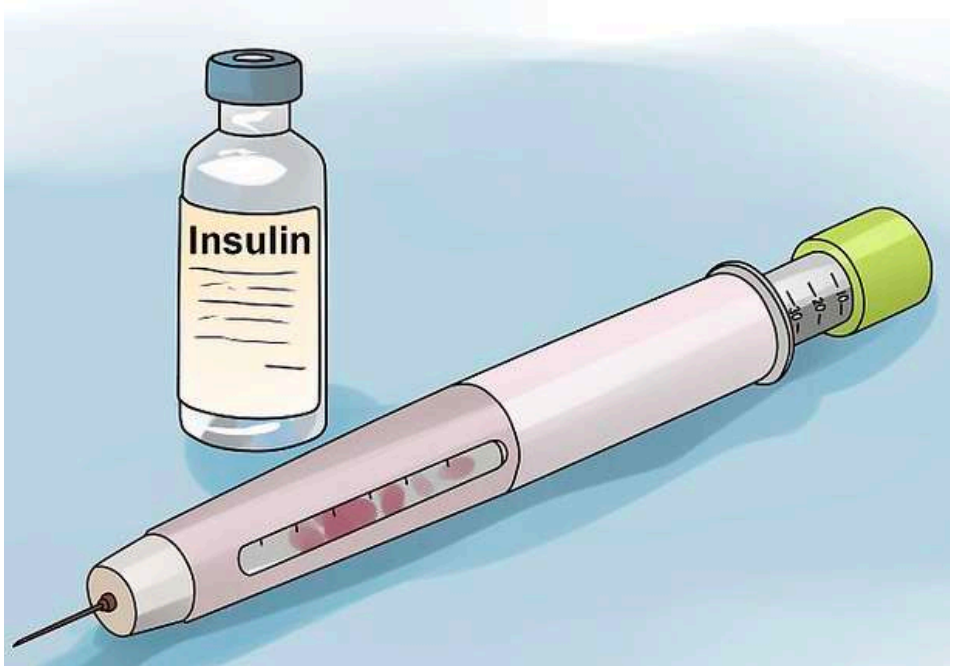
Using insulin to manage glucose post exercise



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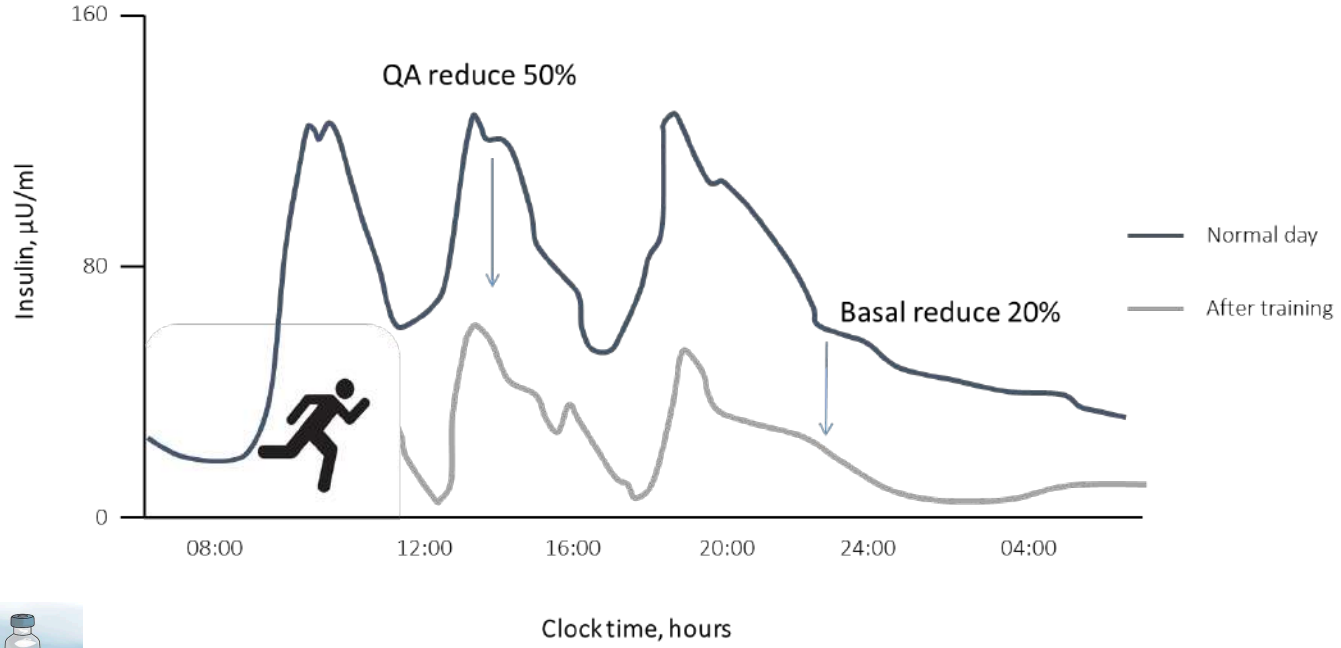
Effect of exercise on Insulin sensitivity



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The 50-50-20 rule

- 50% reduction of normal bolus for next 2 meals
- 50% reduction of normal correction for the next 12 hours
- 20% reduction of normal evening background if:
  - after 4pm
  - over 2 hours of exercise
  - HIT at any time of the day

  - MDI - only applies to glargine / determir / intermediate acting insulin
  - Pump - 20% reduction background for 6 hours from when gone to bed

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Using carbohydrate to manage glucose post exercise

Three things to think about

- Is your daily carbohydrate correct?
- Are you taking a recovery meal after exercise?
- Do you need to have something before bed?

Recovery food

Did you do more than 60 minutes moderate intensity exercise or more than 30 high intensity exercise?

No → No recovery food needed

Yes → Have food with carbohydrate and protein in Ratio 4:1. For example

Ham sandwich.

Milkshake

Cereal and milk

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Diet Strategies for nocturnal hypoglycemia

Consider bedtime snack with protein and complex carbohydrate if:

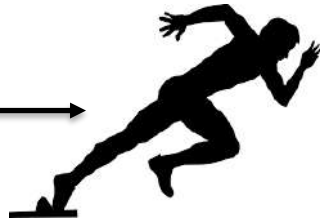
- exercised after 4 pm
- exercised more than 2 hours

Using exercise to manage glucose post exercise

Glucose >10 →

warm down
10 minutes warm
Down lowers by 1-2 mmol

Glucose <4 →



10 sec sprint
Raises by 2-4 mmol
Protects from hypo for
30-40 minutes

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Learning objectives

1. Benefits and barriers to exercise in people with T1D

2. What you need to think about before you exercise
   - What exercise, what time, previous and prevailing glucose

3. What options are available for managing glucose during exercise
   - Insulin (basal/bolus/MDI/pumps), CHO (simple and ExCarbs), exercise

4. What options are available for managing glucose after exercise
   - Insulin (50:50:20 rule), CHO (recovery and daily requirements), exercise

Additional information

- EXTOD patient day: 10th October in Birmingham
- EXTOD conference for HCPs: 9h October in Birmingham
- DTN Libre education programme: https://abcd.care/dtn/education
- Website EXTOD.org

- Specific question can email me – R.C.Andrews@exeter.ac.uk