

# Type 1 diabetes and managing exercise

Rob Andrews

# 6 common questions

- How do different exercises effect glucose and why?
- What should my glucose target be for exercise?
- How can I control glucose during exercise?
- How can I control glucose after exercise?
- Where do I get more information?

How do different exercises effect glucose and why?



# Flexibility exercises



Tai Chi

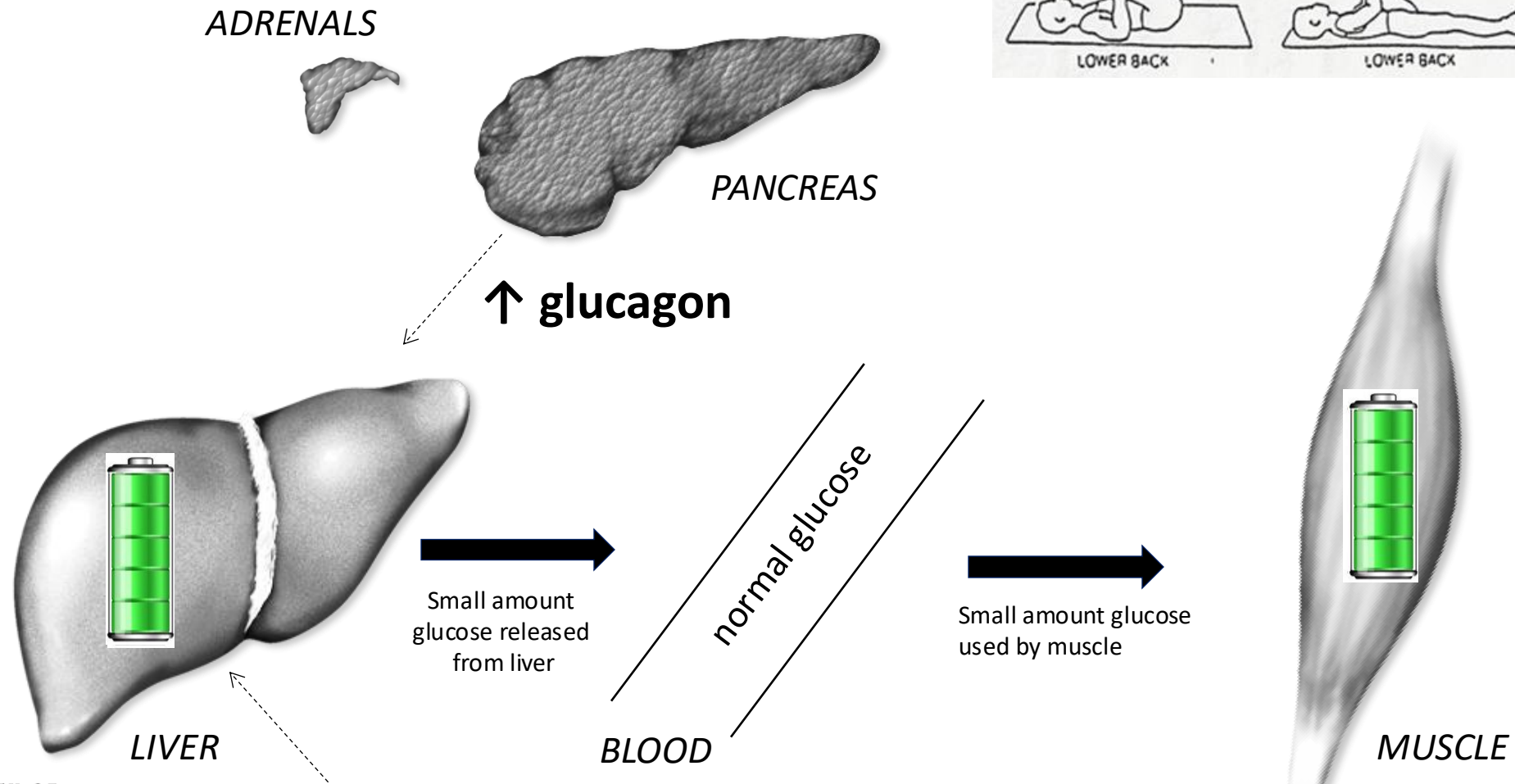


Yoga



Pilates

# Glucose control during flexibility exercises in type 1 diabetes



SC Insulin - level dependent on what given



# Aerobic exercises



Swimming

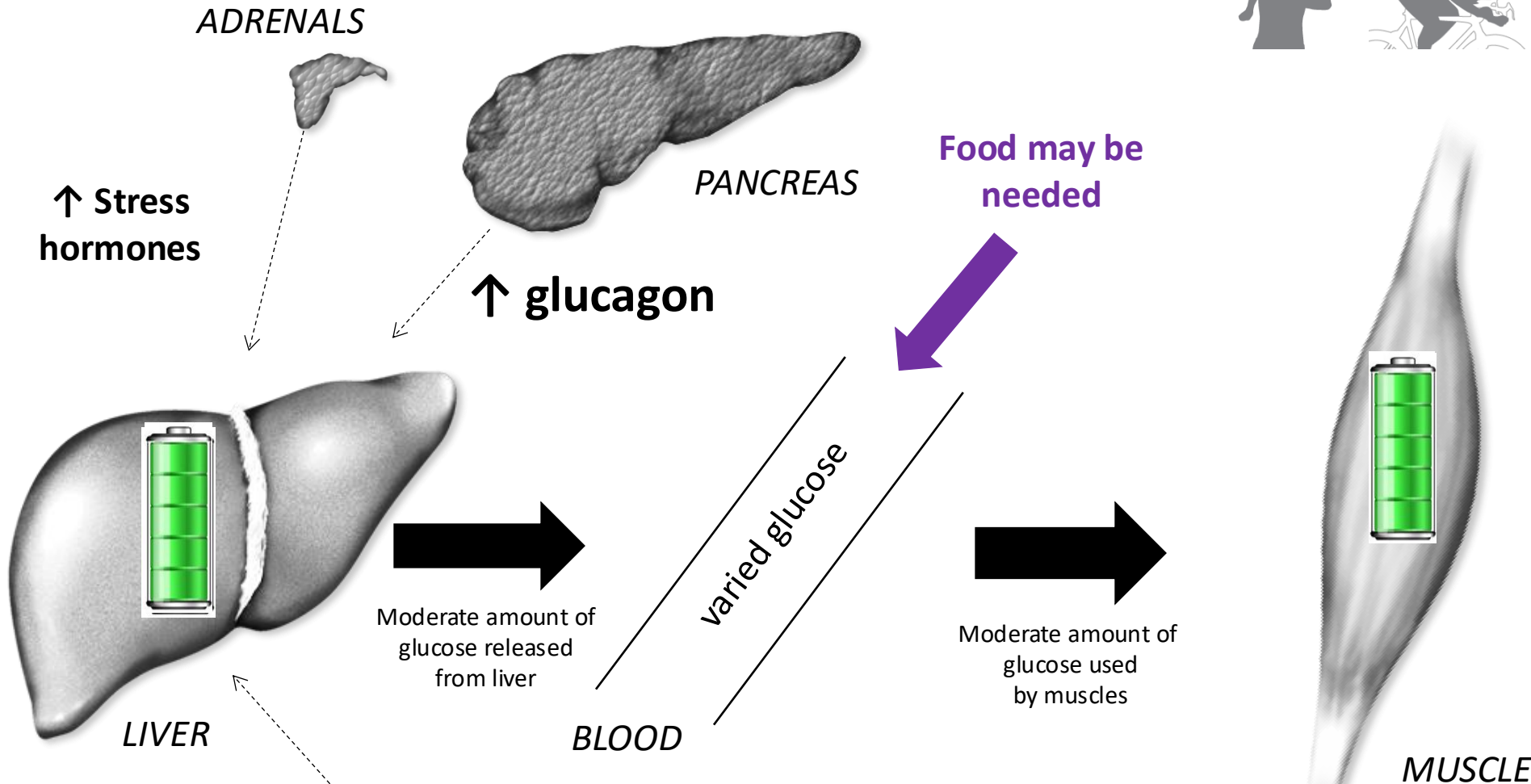


Cycling



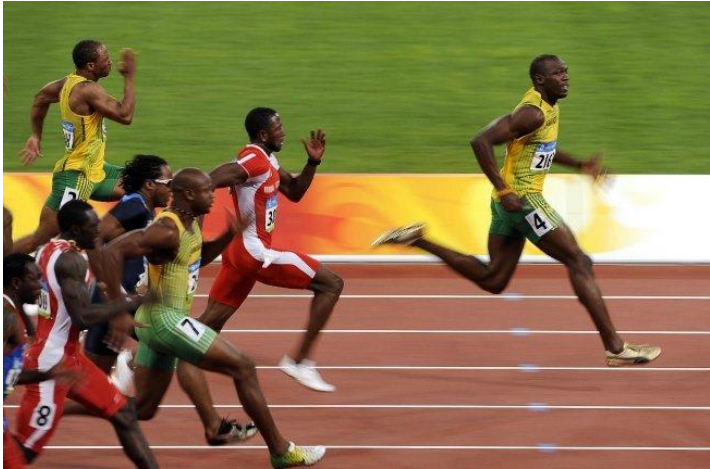
Running

# Glucose control during aerobic exercise in type 1 diabetes



SC Insulin - level dependent on what given

# Anaerobic exercises



Sprinting



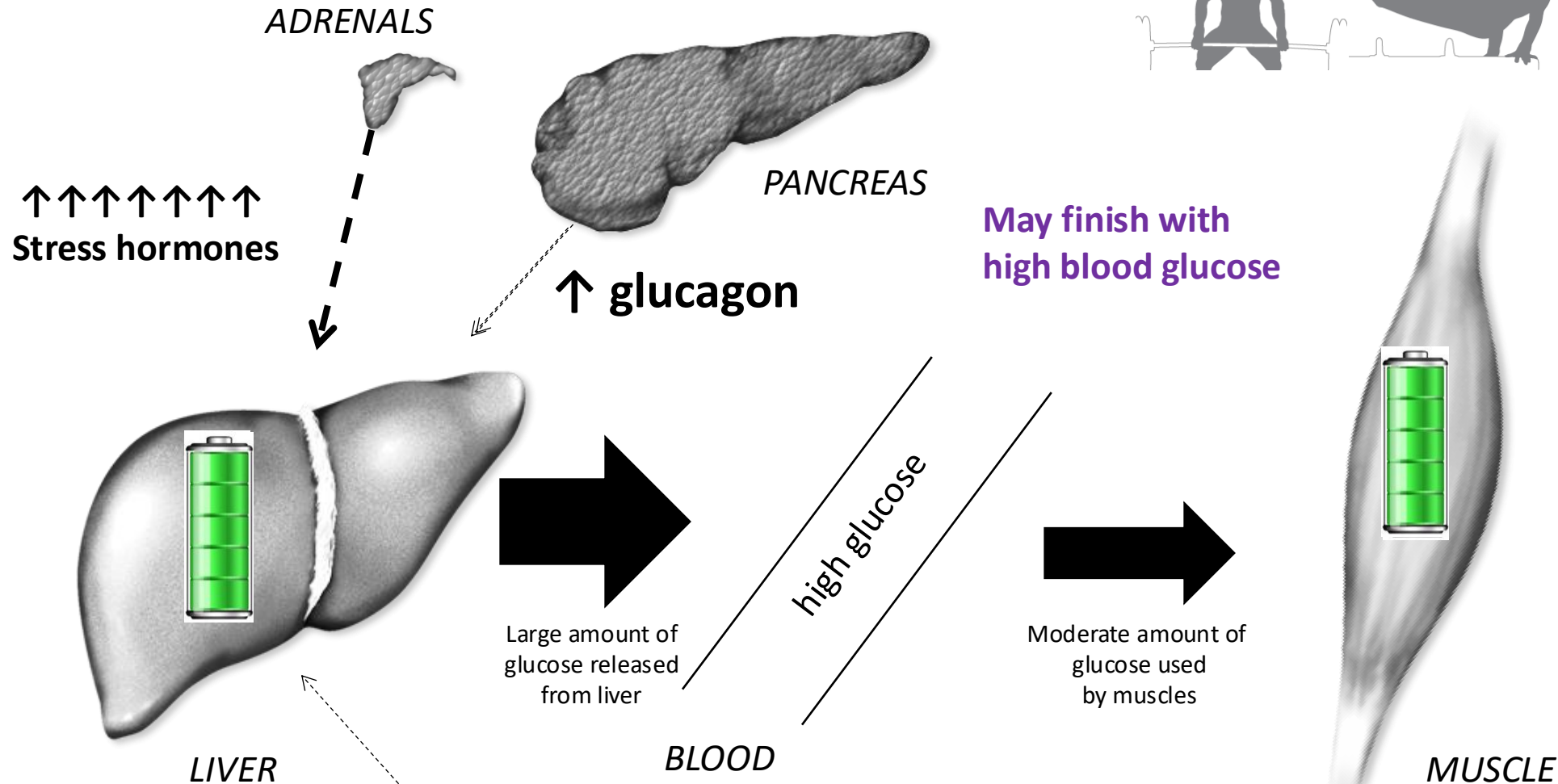
Weight training



Fencing



# Glucose control during anaerobic exercise in type 1 diabetes



May finish with high blood glucose

SC Insulin - level dependent on what given

# Glucose responses to different exercises in type 1 diabetes



Flexibility /  
Stretching



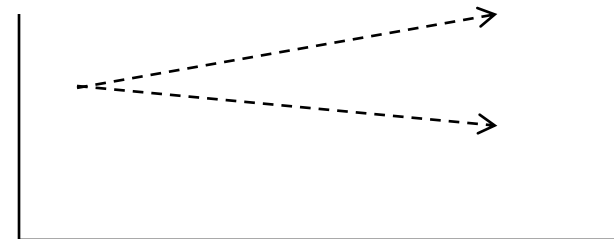
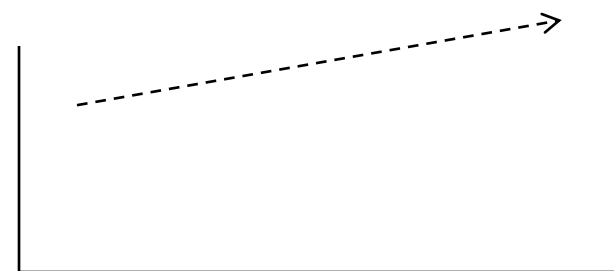
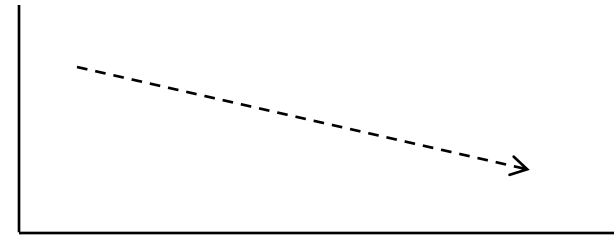
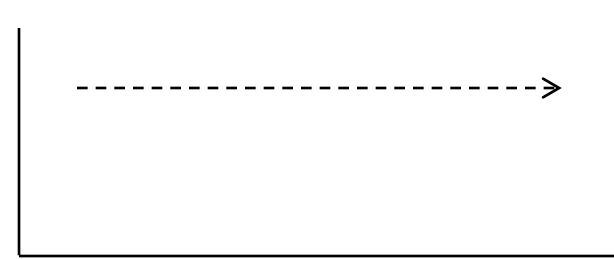
Aerobic



Anaerobic



Mixed

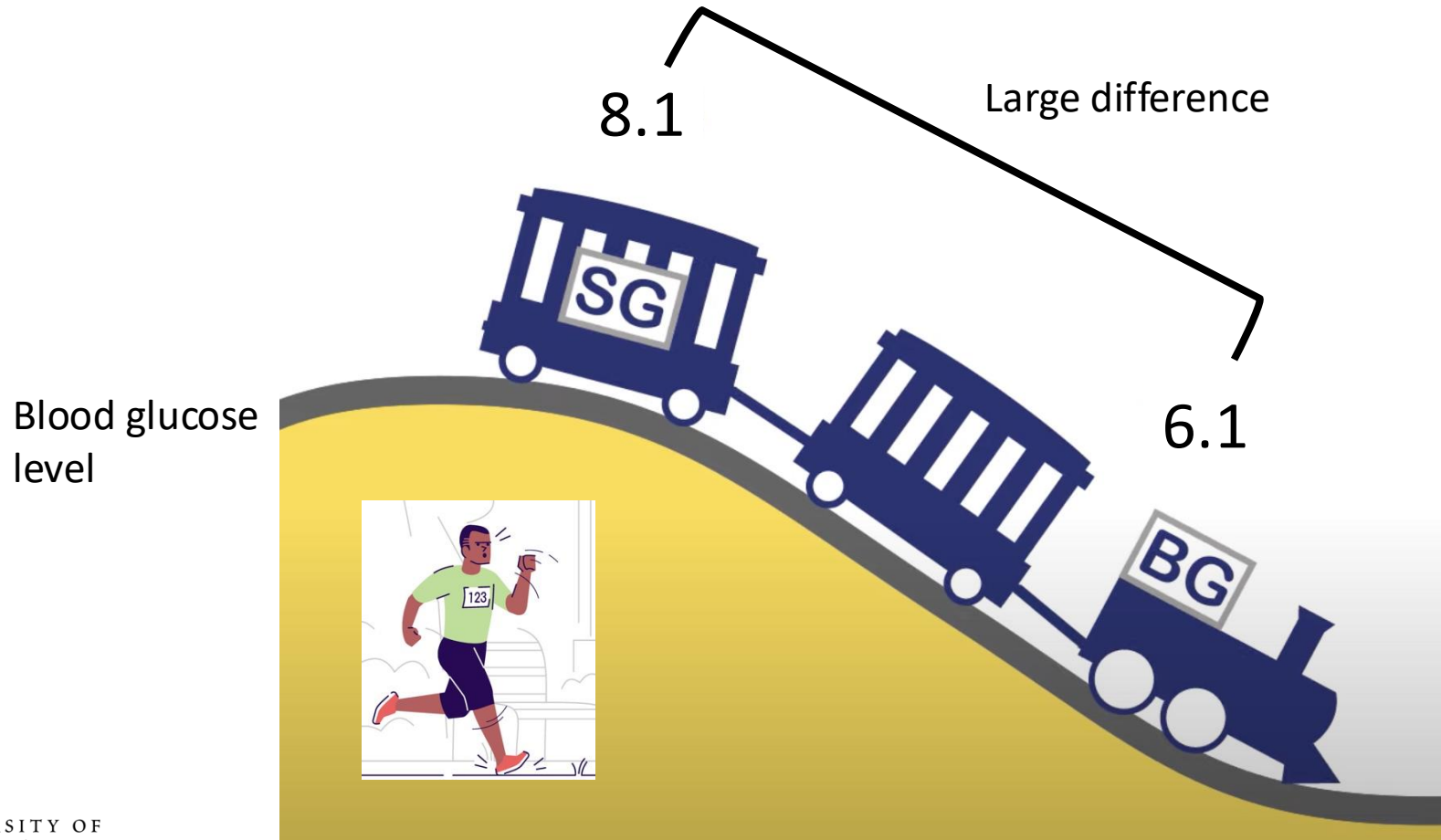


Initial  
Blood  
Glucose  
Change

What should my  
glucose target be  
for exercise?



# Sensor readings during exercise

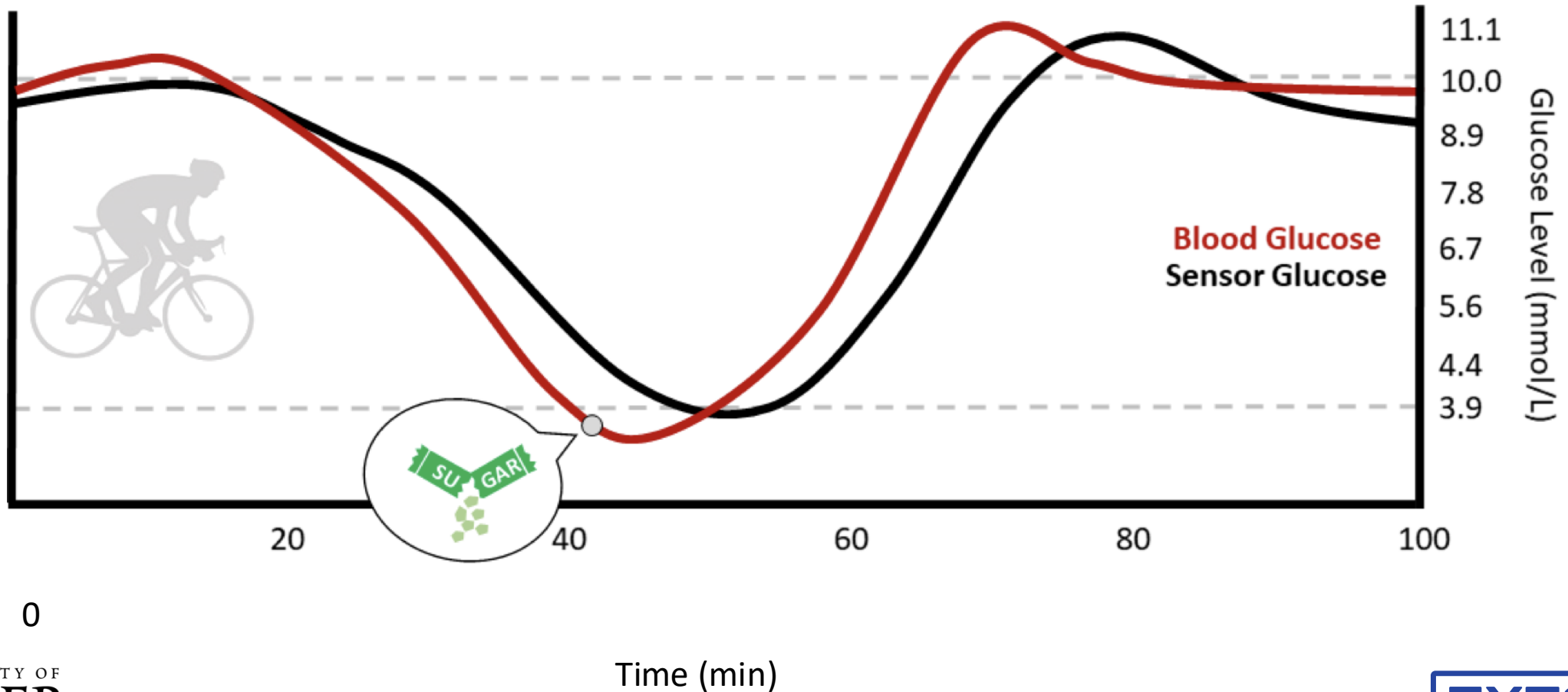


BG = blood glucose

SG = sensor glucose

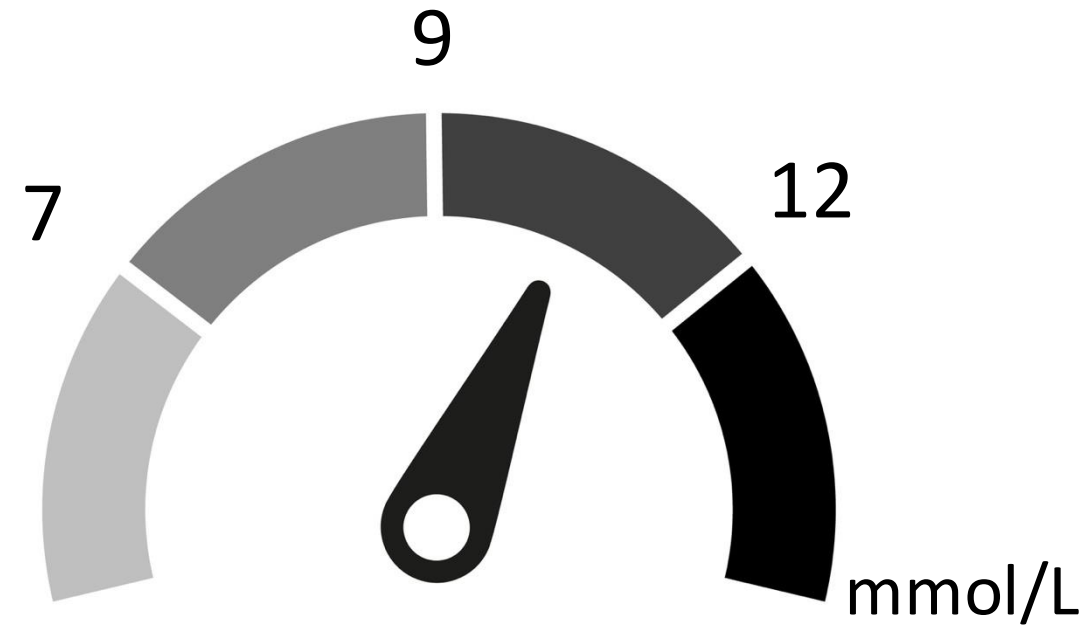
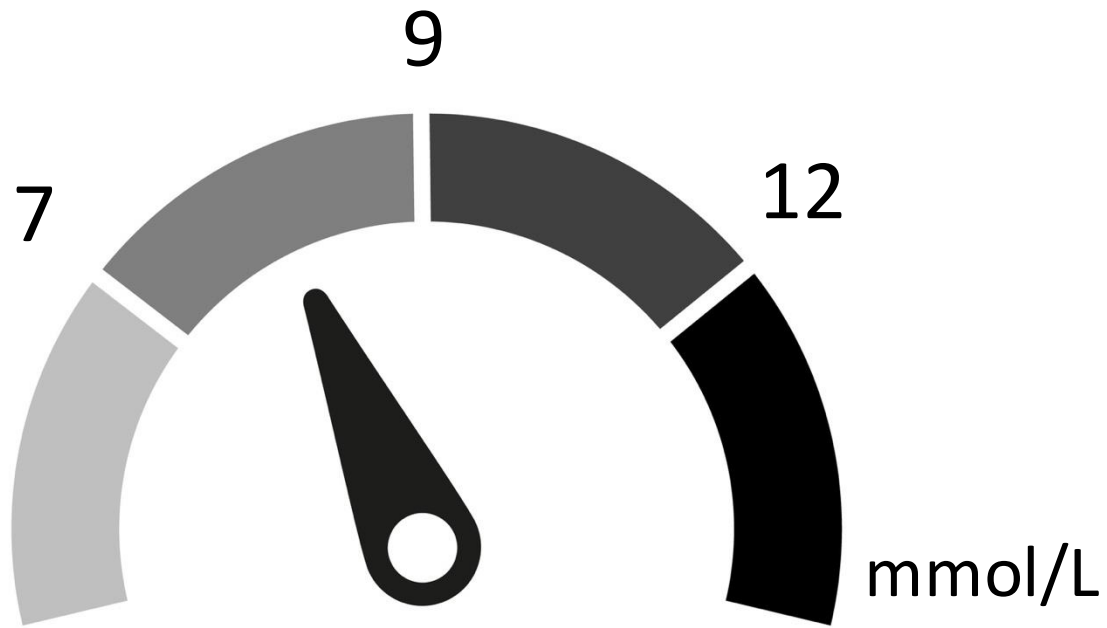


# Sensor readings during exercise



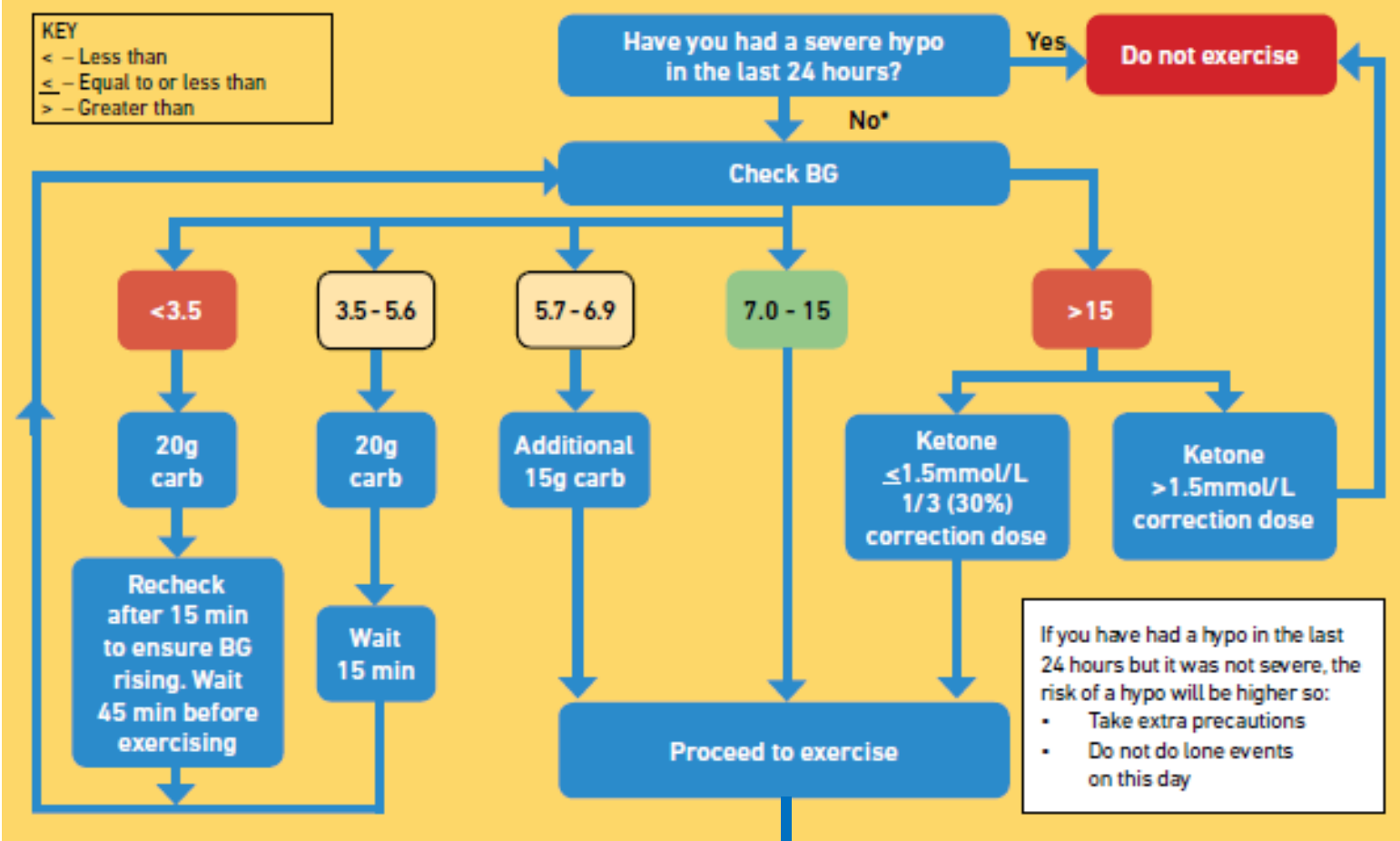
# Sensor glucose target range for exercise

Low hypo risk ↔ High hypo risk



Exercises regularly ↔ Rarely Exercises

# Flowchart of glucose for exercise



### Additional information

Confirm with BG reading if

- Glucose <5.0
- Glucose >15

Libre	Dexcom	Medtronic	Description	% of suggested carbs
		↑↑↑	Rapidly rising	0%
↑		↑↑	Rising	50%
↗		↑	Slowly rising	75%
→			Stable	100%
↘		↓	Slowly falling	125%
↓		↓↓	Falling	150%
		↓↓↓	Rapidly falling	200%

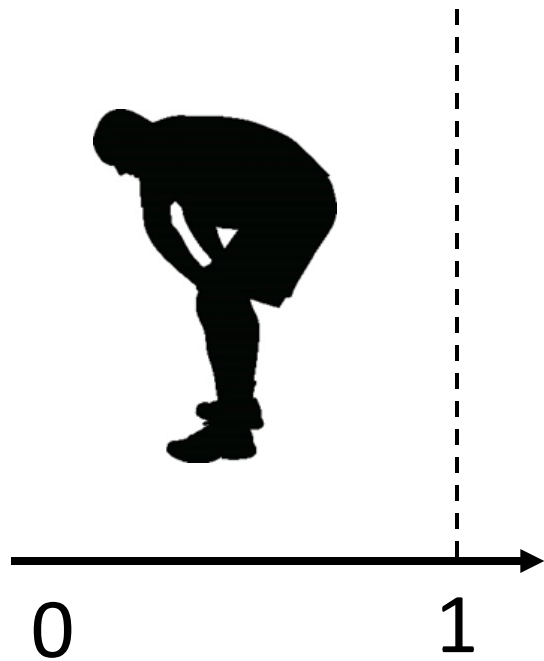
If you have had a hypo in the last 24 hours but it was not severe, the risk of a hypo will be higher so:

- Take extra precautions
- Do not do lone events on this day

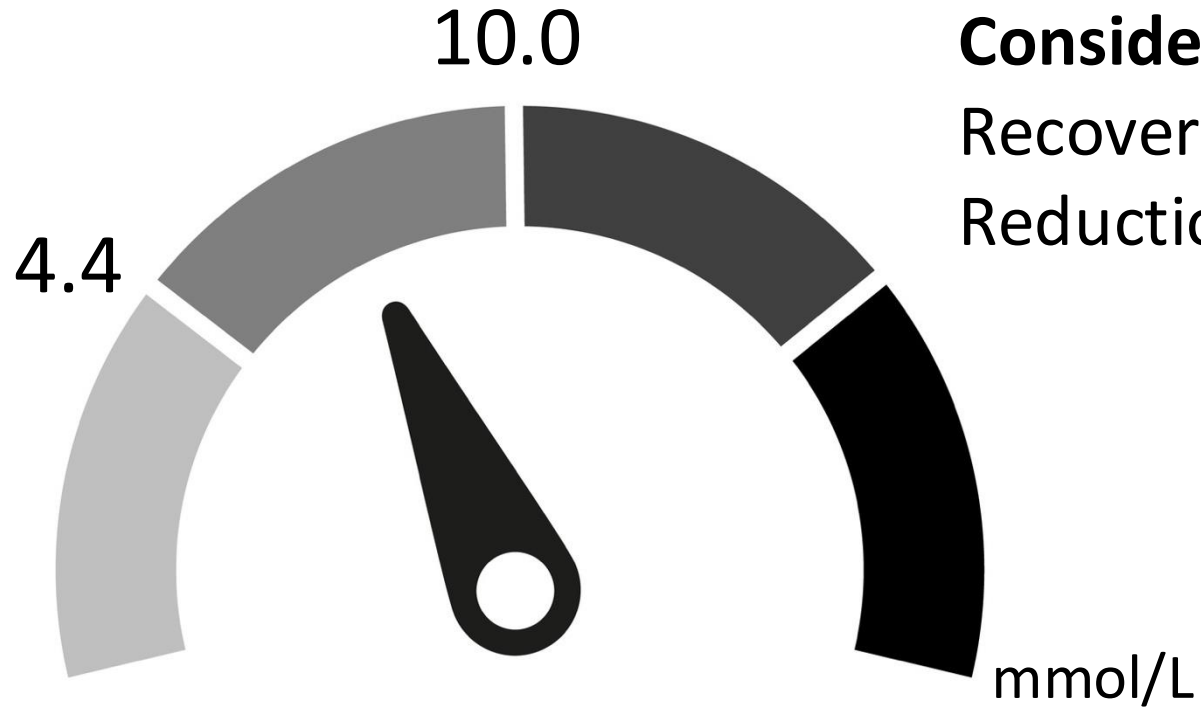
During exercise aim for 7-9 mmol/l  
 (9-12 mmol/L if new to exercise or hypounaware)

First hour after exercise aim for 5-10 mmol/l

# First hour after exercise



Hours after exercise

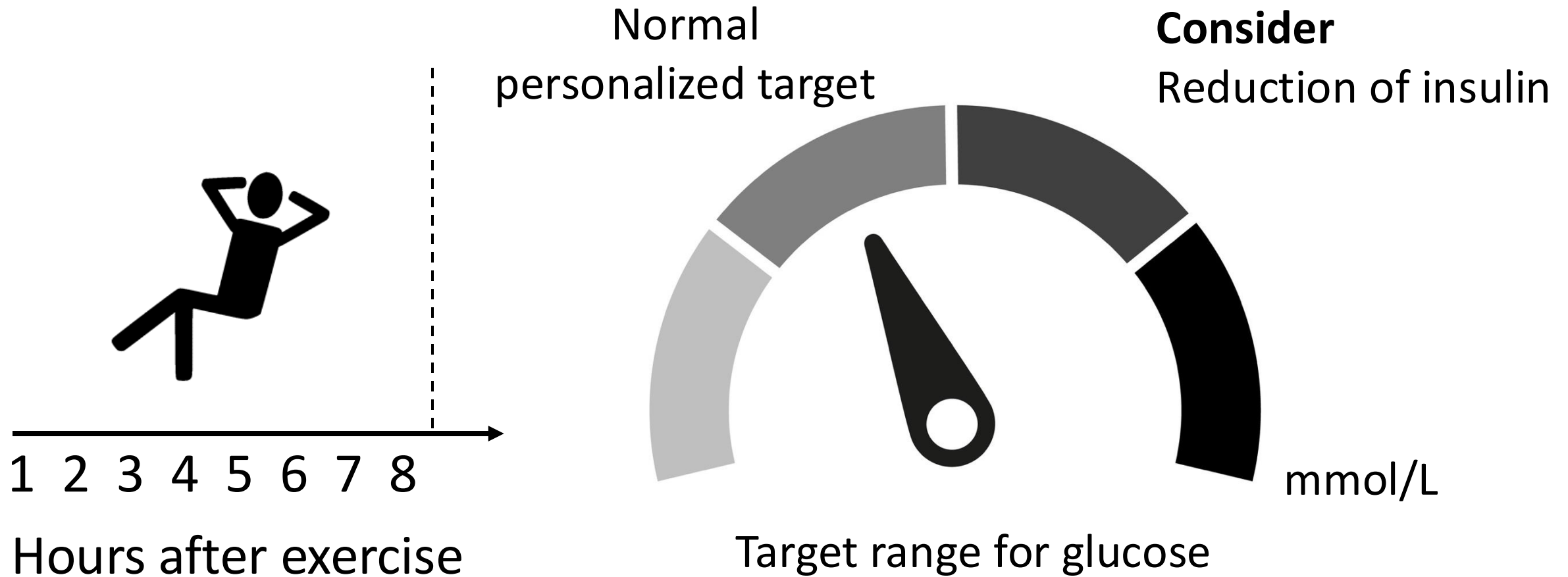


Target range for glucose

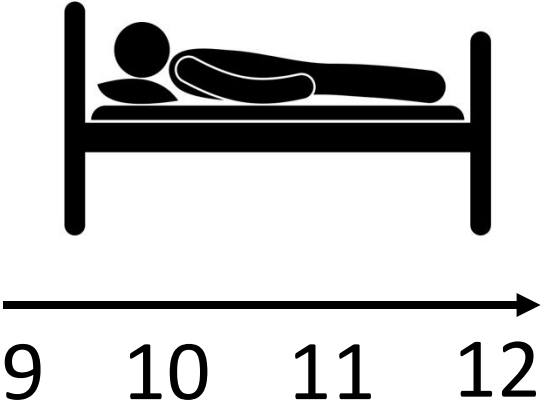
**Consider**  
Recovery food  
Reduction of insulin



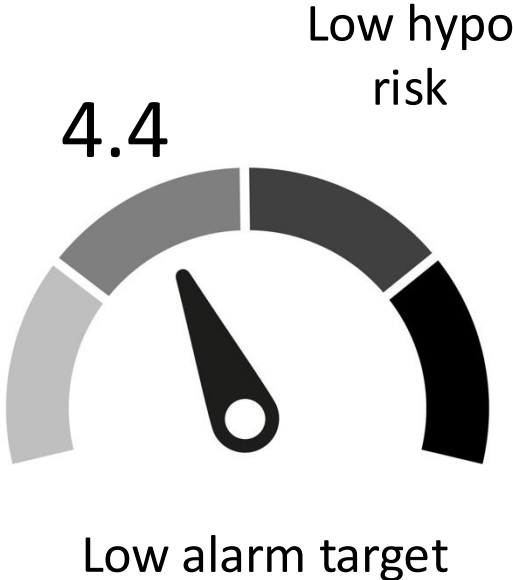
# 1-8 hours after exercise



# Overnight after exercise



Hours after exercise



Low hypo risk

4.4

Low alarm target

Exercises regularly



High hypo risk

5.6



Low alarm target

Rarely Exercises



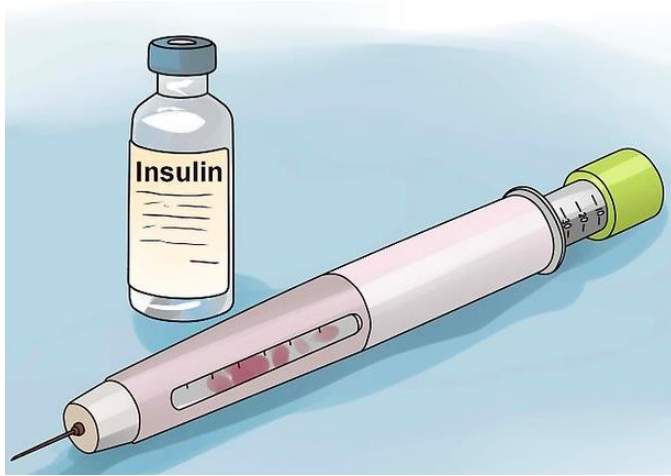
**Consider**

Bedtime snack and/or reduction basal insulin

How can I control  
glucose during  
exercise?



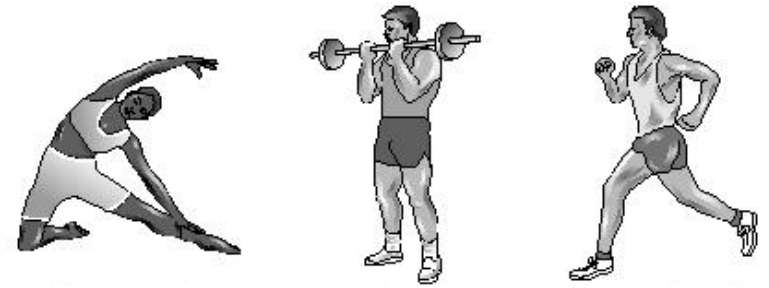
# Three ways to manage glucose during exercise -ICE



Insulin



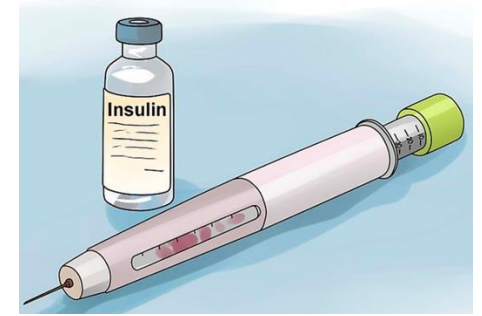
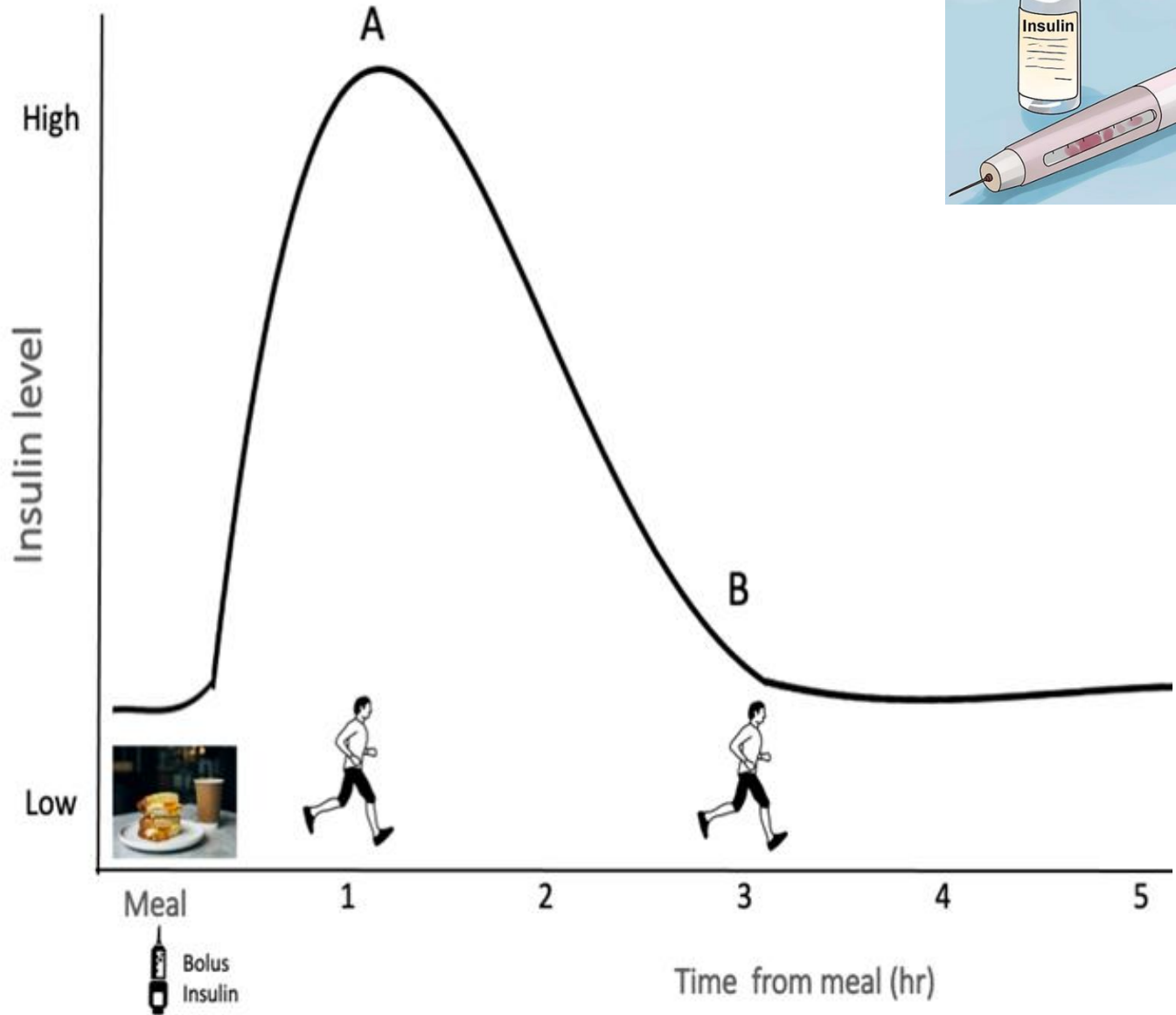
Carbohydrate



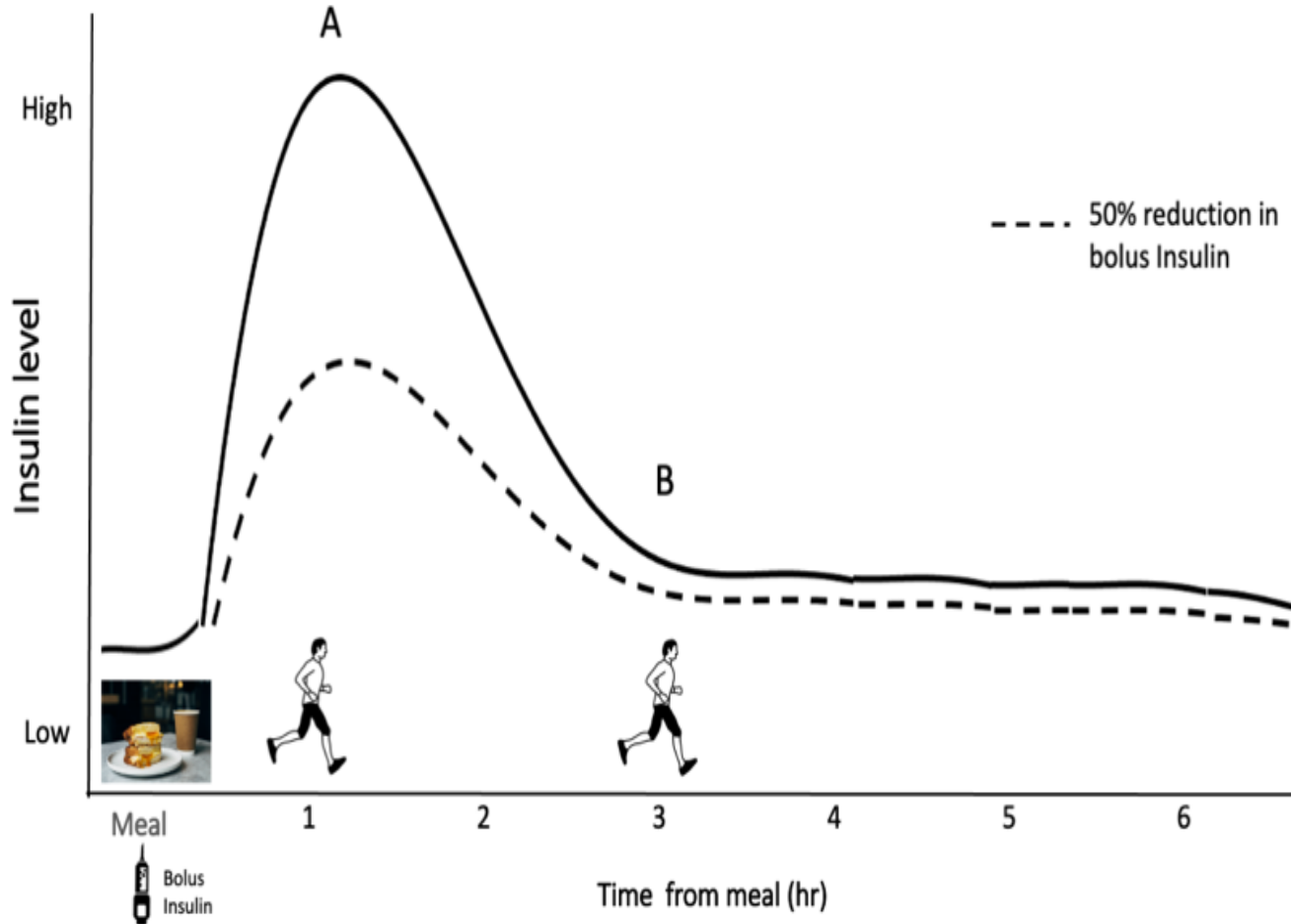
Exercise



# Exercising around meal times



# Simple strategy for meal-insulin



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

## MDI

- Reduce pre-exercise fast acting (bolus) insulin by 50% - No change to background

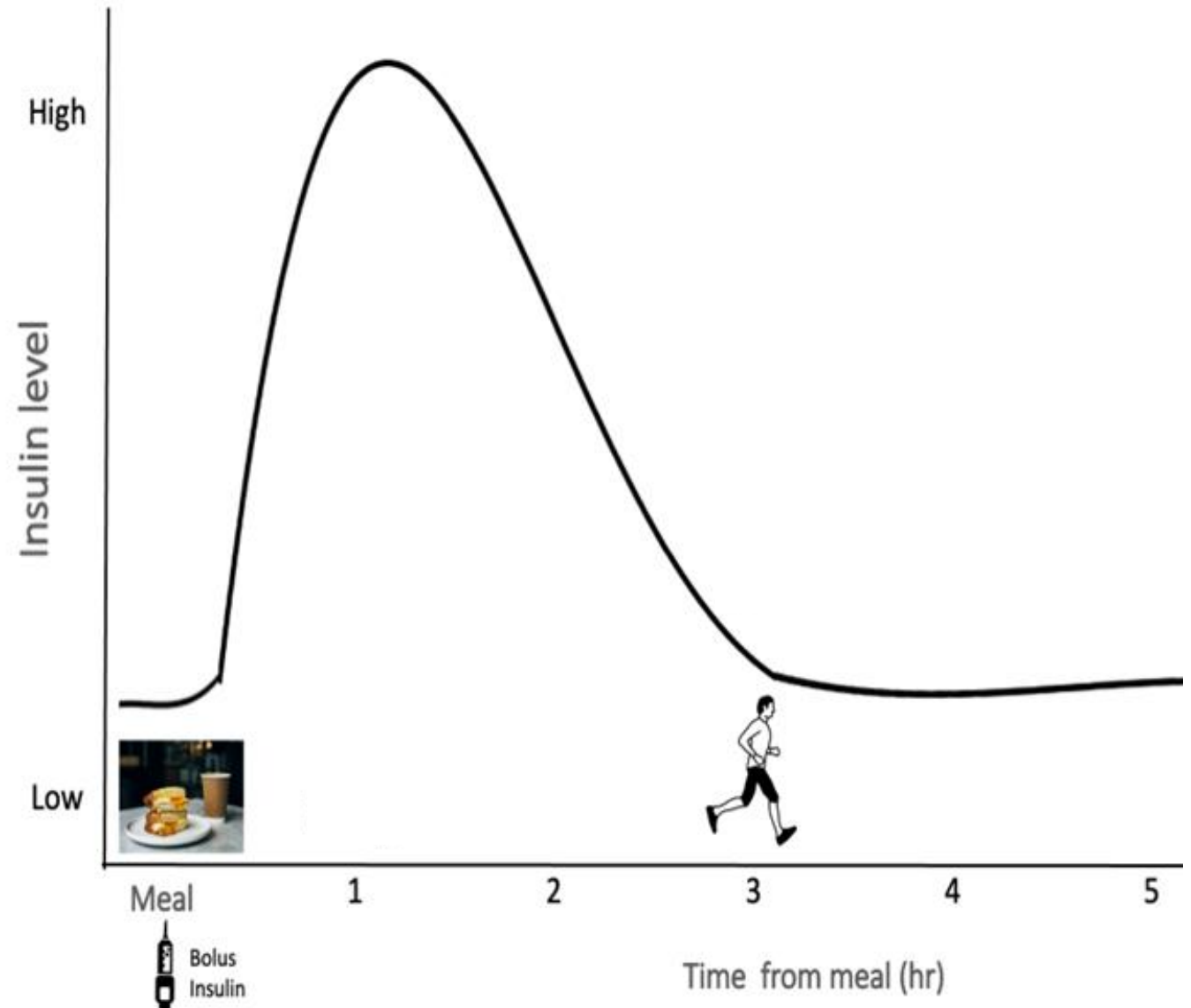
## Pumps

Reduce pre-exercise fast acting (bolus) insulin by 50% - No change to background unless exercising longer than 90 minutes

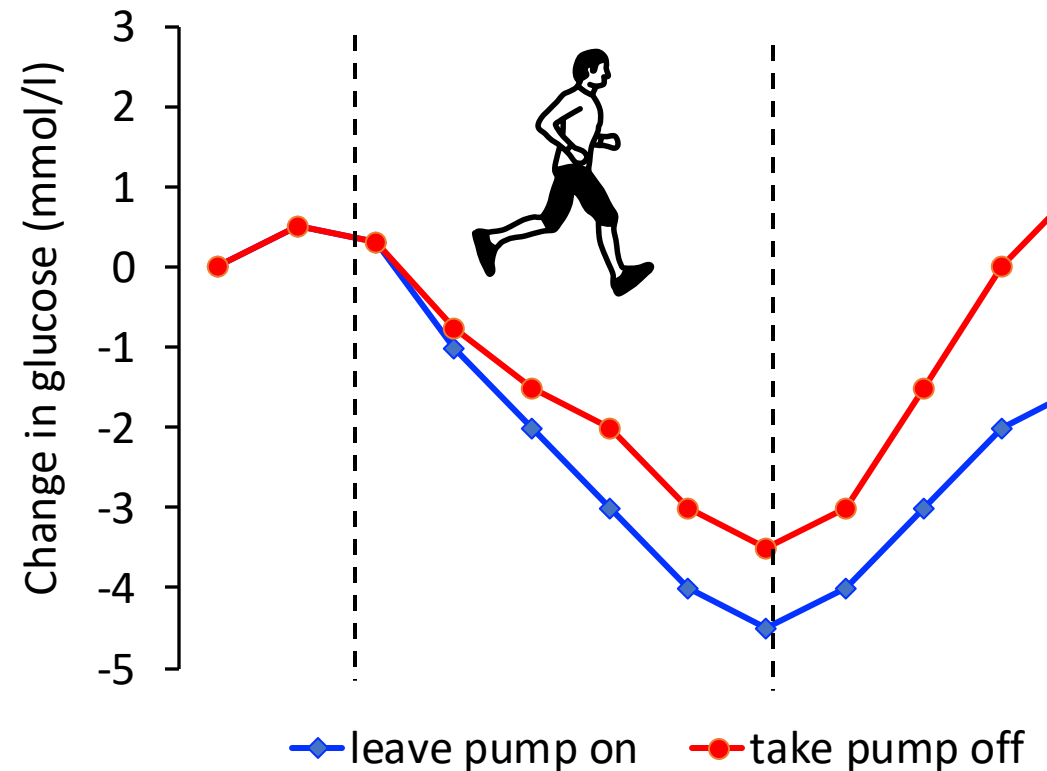
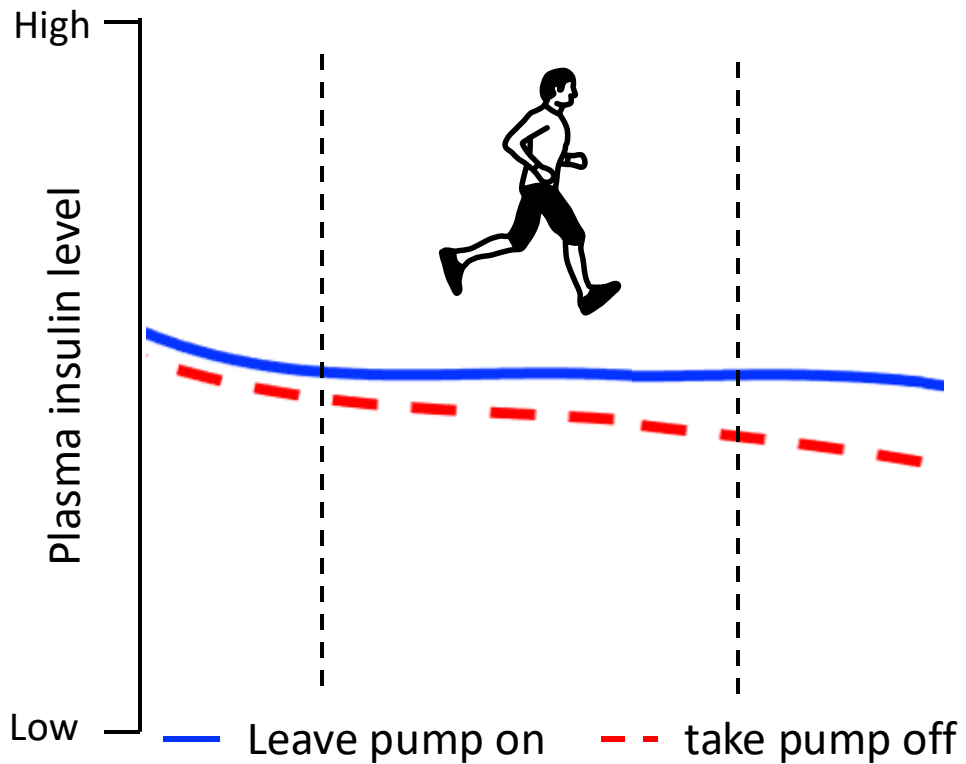
## Closed loops systems

Reduce pre-exercise fast acting (bolus) insulin by 30% + exercise target 90 minutes before

# Exercising between meals

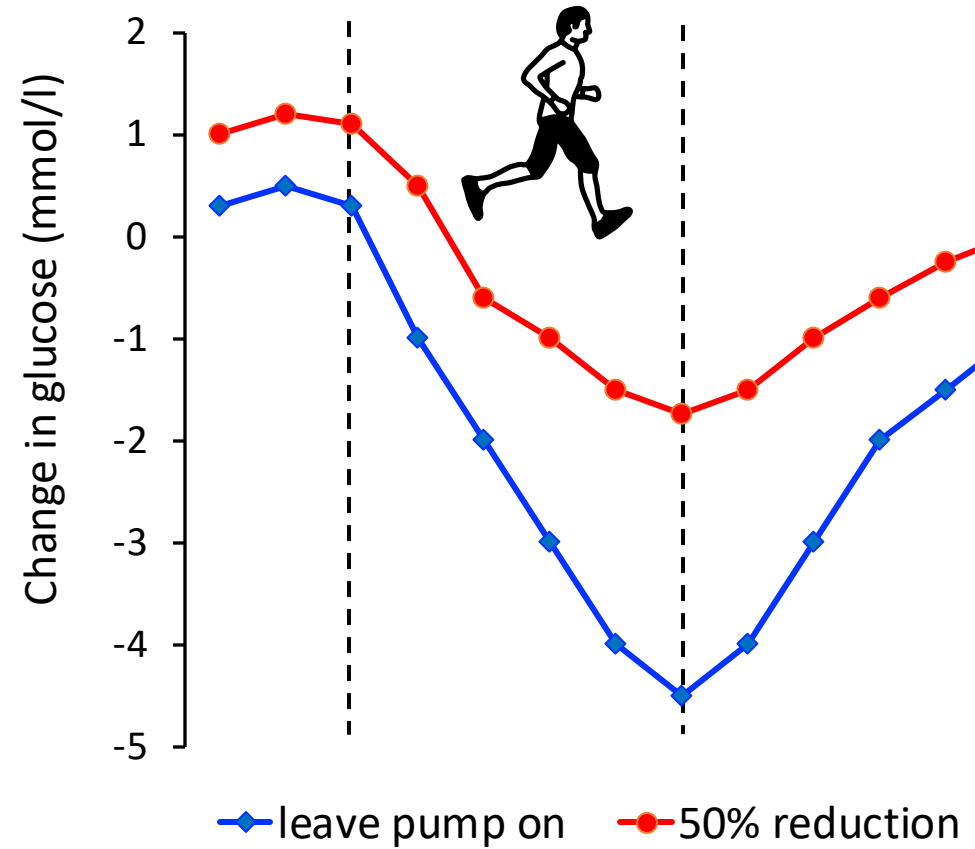
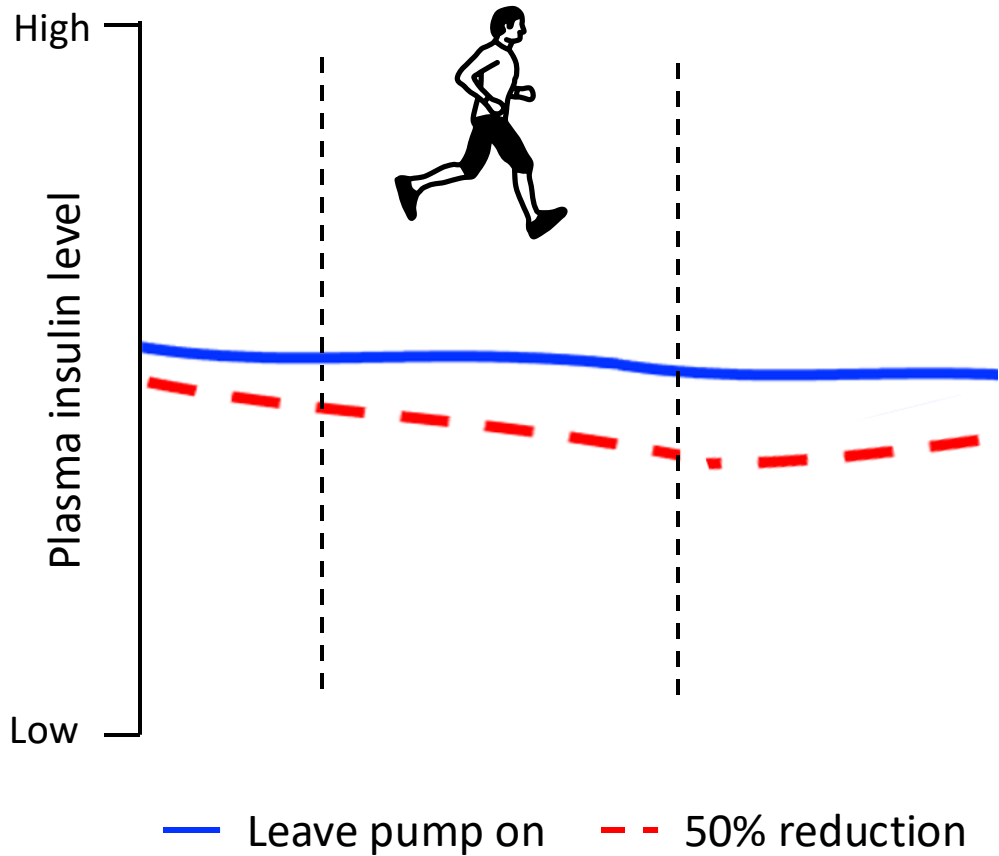


# Effect of taking off pump

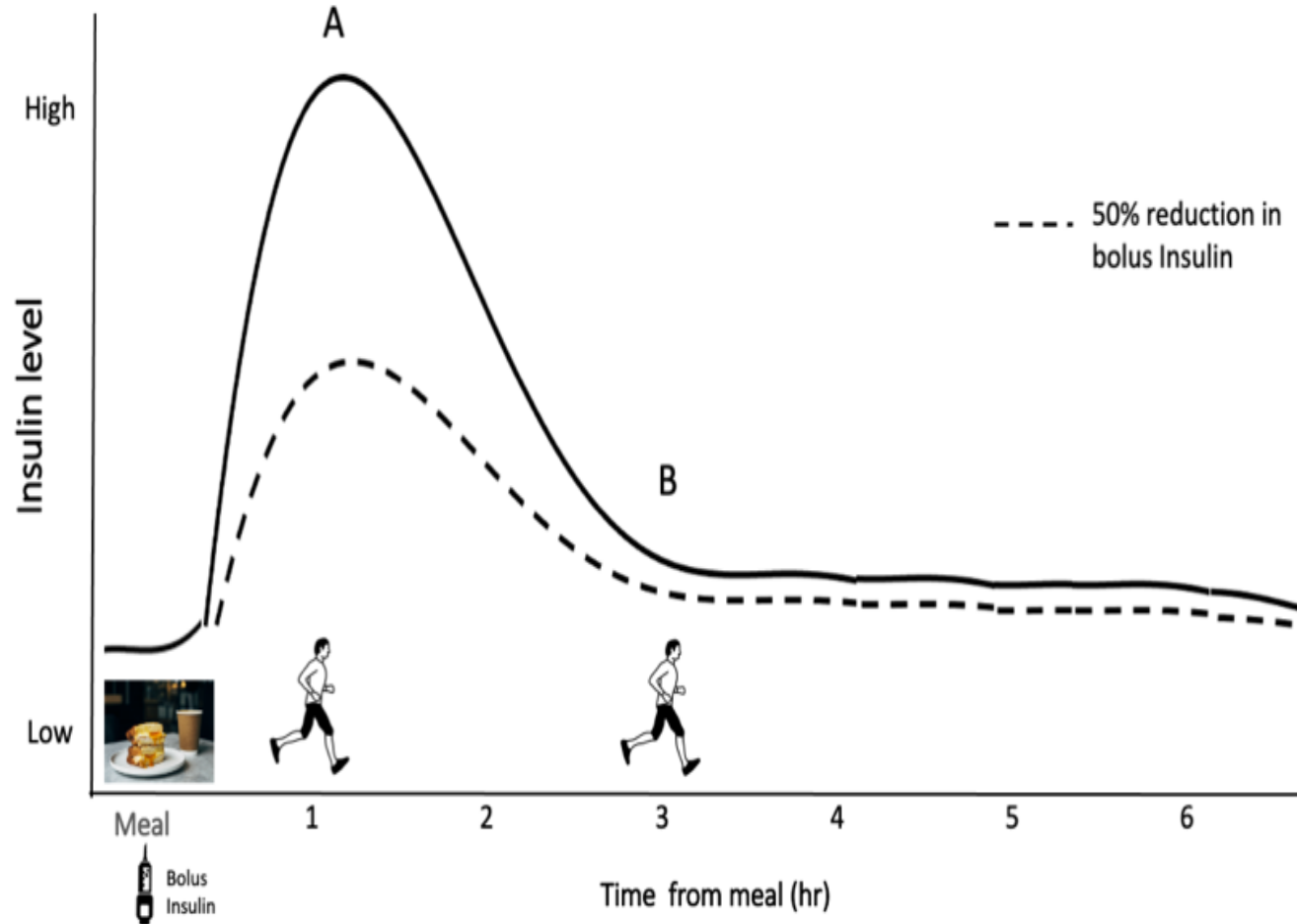




# Reducing by 50% before exercise



# Simple strategy for insulin when exercising between meal



If exercising greater than 2 hours after meal

## MDI

- No change bolus- only change background if very prolonged exercise.

## Pumps

No change bolus- 50% reduction background from 90 minutes before exercise until the end.

## Closed loops systems

No change bolus - exercise target 90 minutes before exercise until the end

# Changes in basal rate for exercise

- 50% reduction in basal rate from 90 minutes before exercise to finish of exercise
- If spontaneous exercise taking off pump can provide some protection

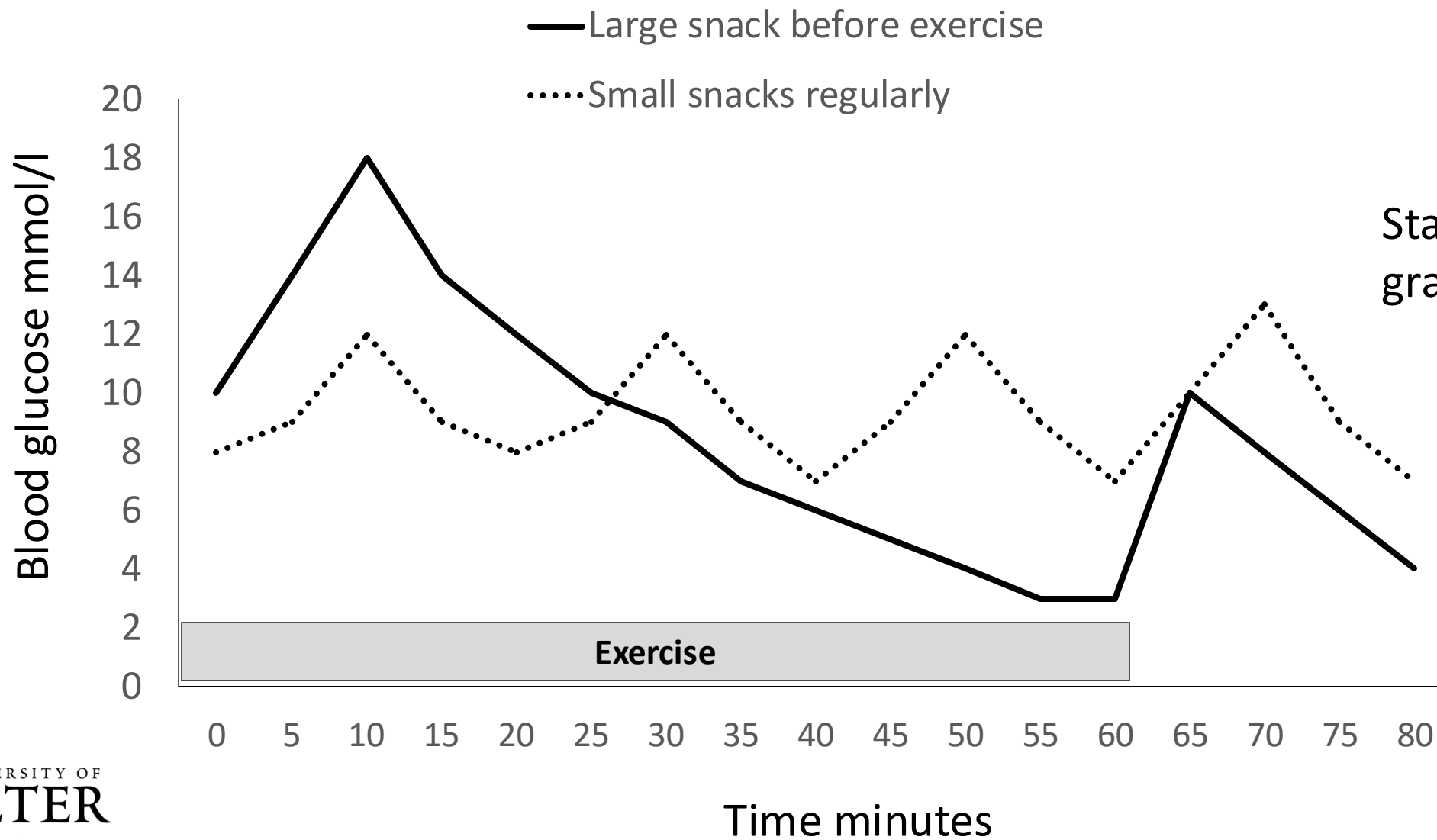
## If on hybrid closed loop

- First try just going to exercise mode 90 minutes before exercise.
- If not working and exercising within 2 hours of meal then try  $1/3$  less bolus with meal and exercise mode 90 minutes before exercise

# Take carbohydrate every 20 minutes



Start with 0.5  
grams/ kg / hr



## If on hybrid closed loop

If glucose still falling in exercise mode take half your normal carbohydrate for exercise adapting with CGM reading and trend arrows.

If need to take more then do not take more than 10-15 grams in one go. Take small an often.



# During exercise – glucose replacement using CGM

Based on guidelines John Pemberton has made a PDF that people can work out how much carbohydrate to take dependent on flash or continuous glucose readings

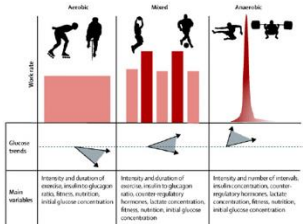
## Type 1 Diabetes Exercise Carbohydrate Calculator

I agree: This is for information only and I will check with my diabetes team  Yes  No

1. What's your name  2. What activity are you doing?  3. Weight in kilograms (kg)?

4. What is your exercise hypoglycaemia risk?

5. What type of activity are you doing (see pictures)?  9. What glucose units does your device use?  10. At what glucose & ketone level should you stop exercise?



Activity	Main variables
Aerobic	Intensity and duration of exercise, insulin to glucose ratio, insulin sensitivity, initial glucose concentration
Mixed	Intensity and duration of exercise, insulin to glucose ratio, counter-regulatory hormones, lactate concentration, stress, nutrition, initial glucose concentration
Anaerobic	Intensity and number of intervals, insulin concentration, counter-regulatory hormones, lactate concentration, stress, nutrition, initial glucose concentration

Guidelines the Type 1 DEC is based on (click & read):

- [Moser et al \(2020\) EASD/ISPAD CGM & Exercise](#)
- [Adolfsson et al \(2018\) ISPAD Paediatric Exercise](#)
- [Riddell et al \(2017\) Type 1 Exercise Consensus](#) (where the graphic is from)

**Disclaimer**

- Carbohydrate plans must be made by a qualified diabetes professional
- Always consult a qualified diabetes professional before trying or adapting a plan

[www.theglucoseneverlies.com](http://www.theglucoseneverlies.com)

# During exercise – glucose replacement using CGM

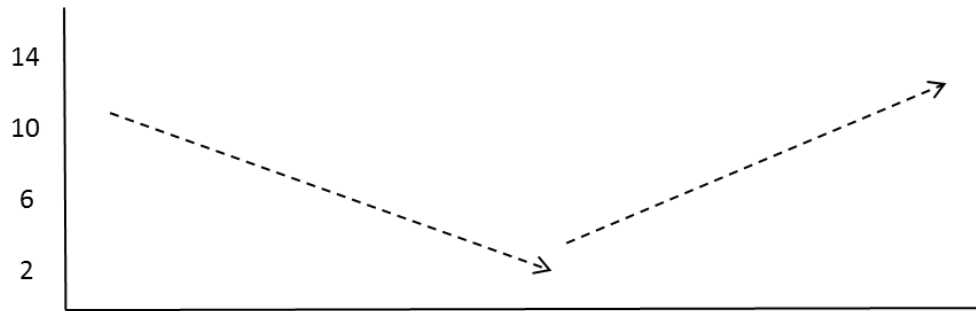
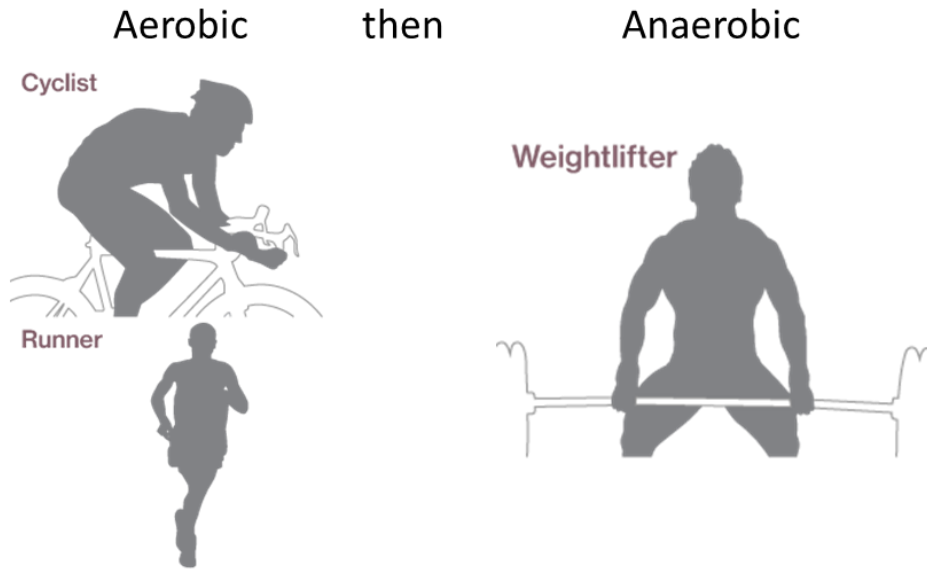
What looks like if on glucose loop system

Rob Andrews		running		
Sensor glucose Levels	Rate of glucose change trend arrow & action to take	Carbohydrate grams needed for 20 minutes	Dextrose (3g)	Glucotab (4g)
less than 4.0 mmol/l	No exercise: Treat hypoglycaemia	9	3	2
4.0 - 6.4 mmol/l	↓↓	20	7	5
	↓	16	5	4
	↘	13	4	3
	→	10	3	3
	↗	7	2	2
	↑	4	1	1
6.5 - 9.9 mmol/l	↓↓	16	5	4
	↓	13	4	3
	↘	10	3	3
	→	7	2	2
	↗	4	1	1
10.0 - 13.9 mmol/l	Ok to exercise with any arrow			
>14.0mmol/l	Check ketones: If less than 0.6mmol/l	Ok to exercise		
	Check ketones: If 0.6mmol/l or above	No exercise until the ketones have been corrected and are less than 0.6mmol/l		

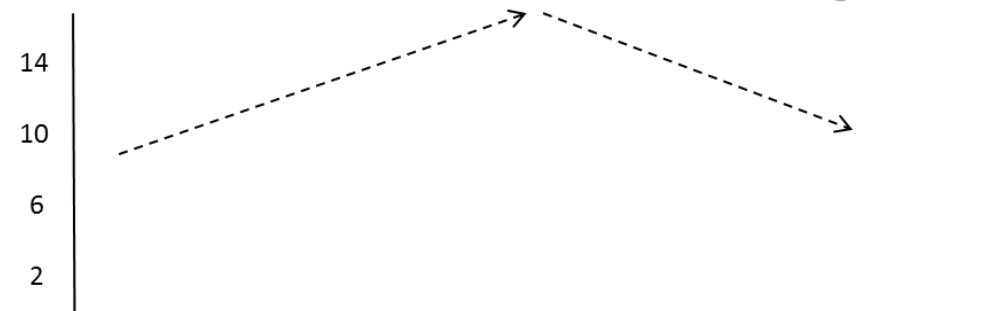
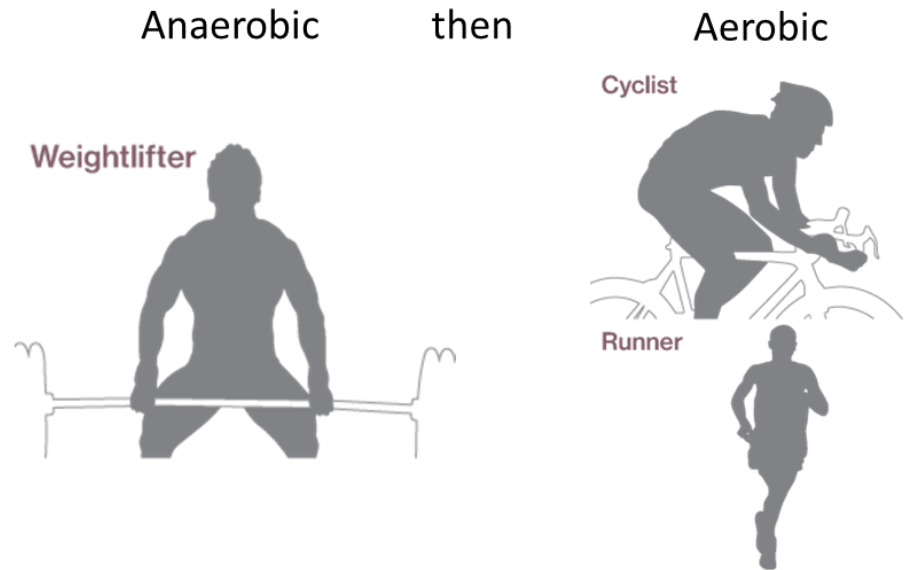
# Order of exercise



Order 1



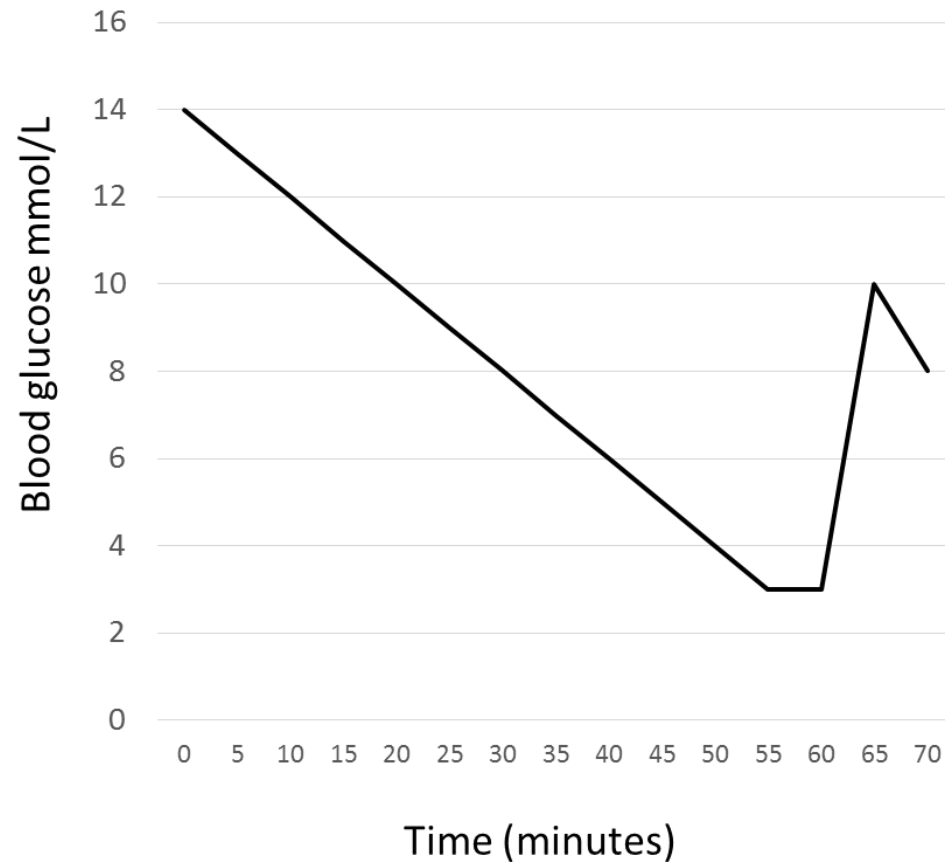
Order 2



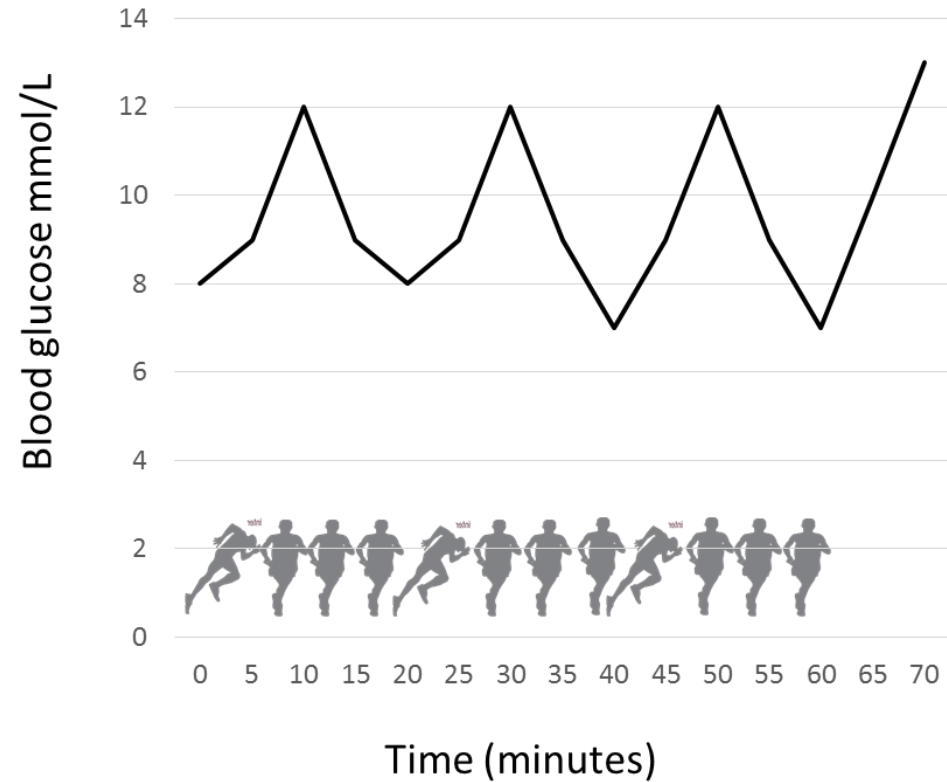
# Sprinting increases your glucose



## Continuous exercise



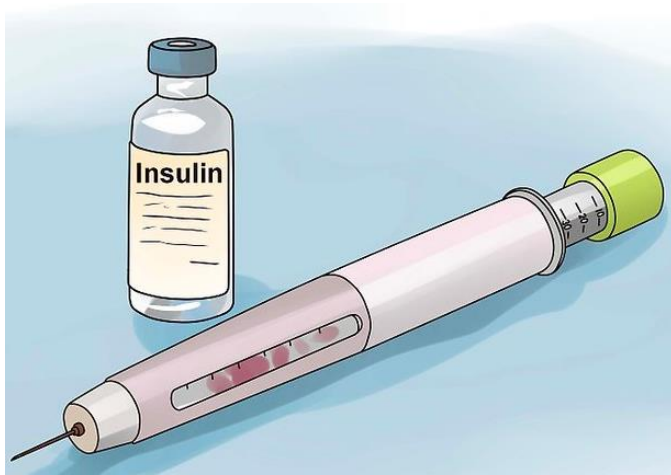
## Continuous exercise + sprints



How can I control  
glucose after  
exercise?



# Three ways to manage glucose post exercise **ICE**



Insulin

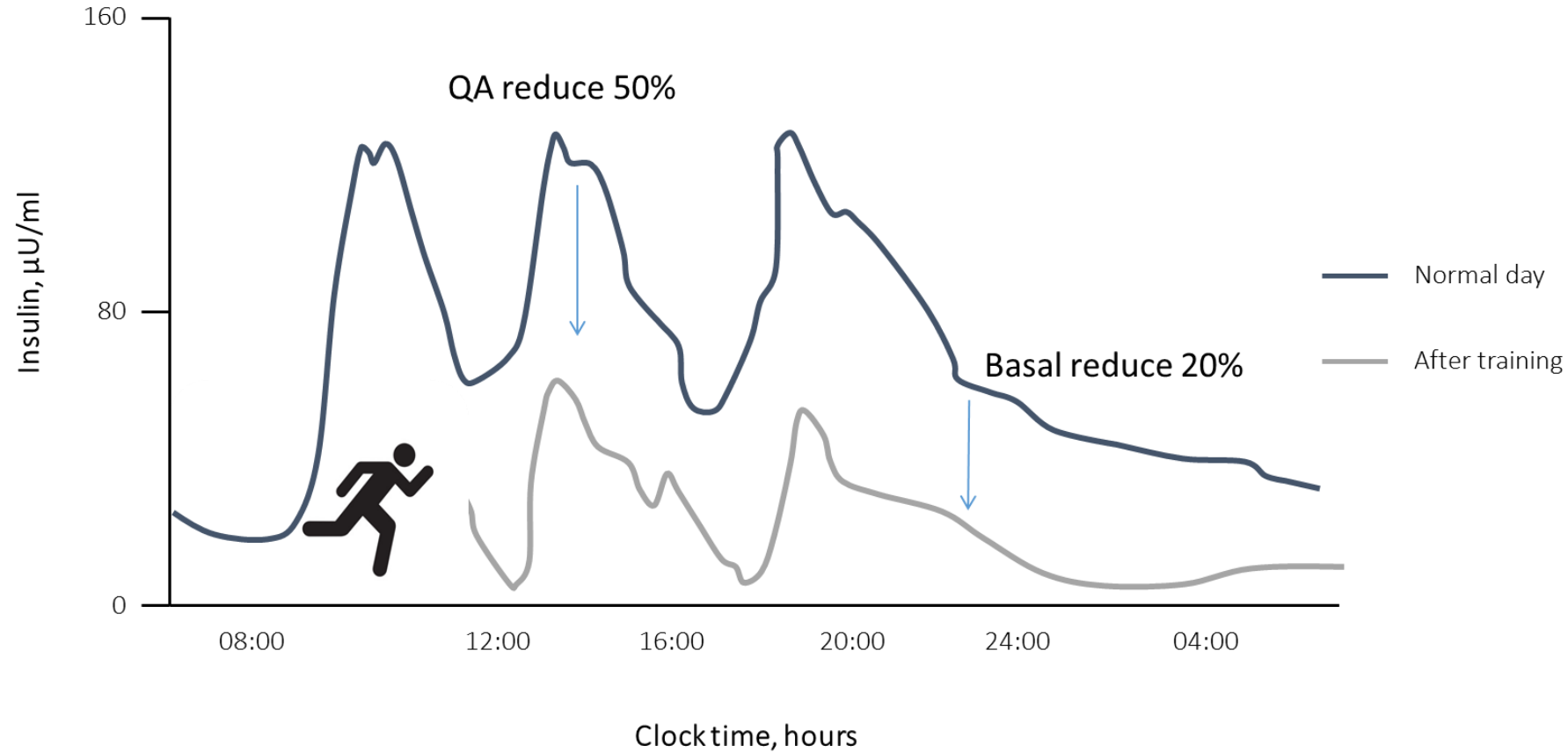


Carbohydrate



Exercise

# Effect of exercise on Insulin sensitivity





# 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 / detemir / intermediate acting insulin
- Pump - 20% reduction background for 6 hours from when gone to bed

# Hybrid close loops - after exercise

- 25% less bolus for first meal
- Keep at exercise target for first few hours if prolonged exercise
- Return to normal set points overnight

# 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

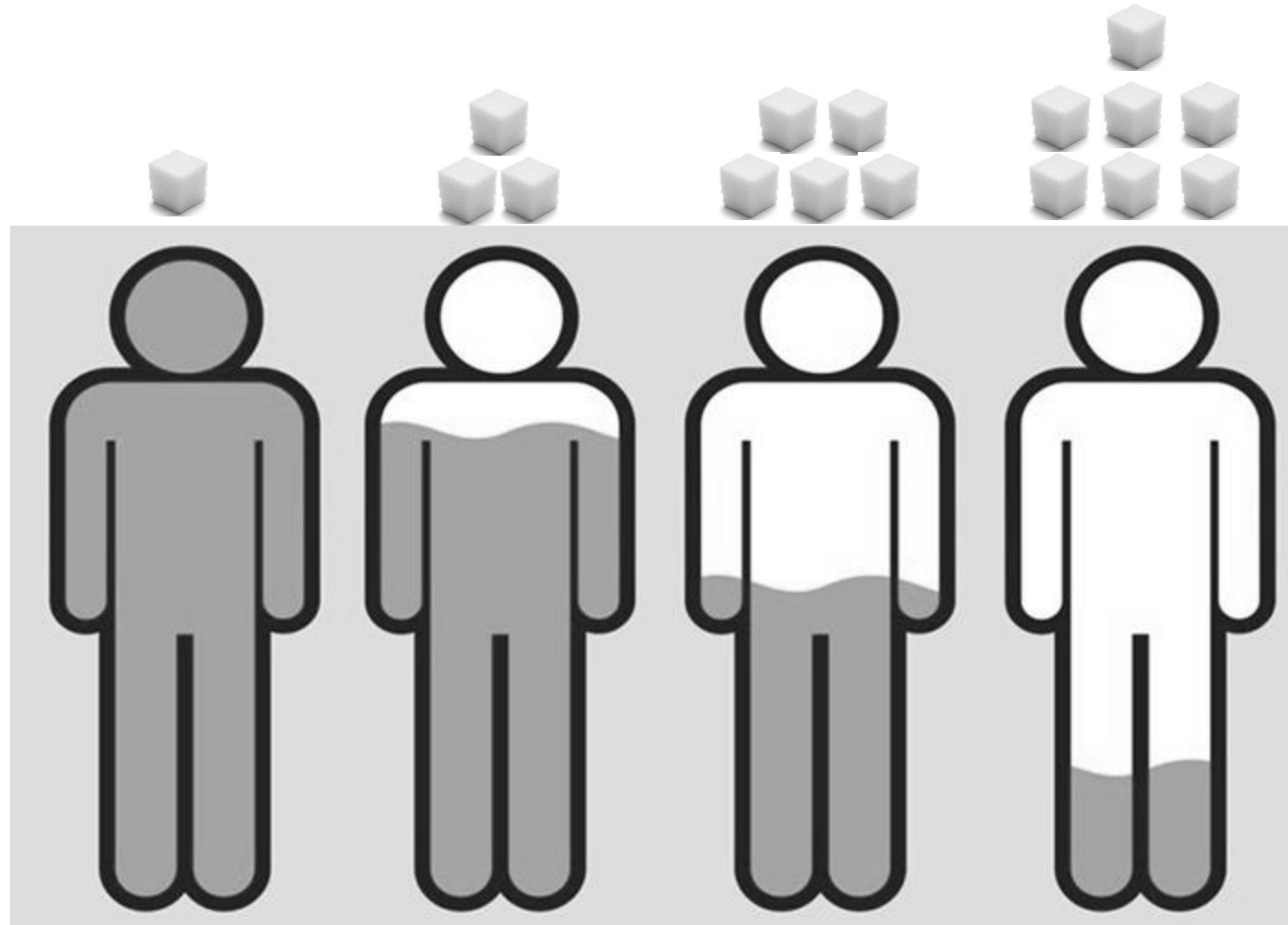


Cereal and milk



# High blood glucose post exercise

Blood glucose concentration



Dehydration may be a cause of raised glucose

Thus rehydration may lower glucose

Dehydration



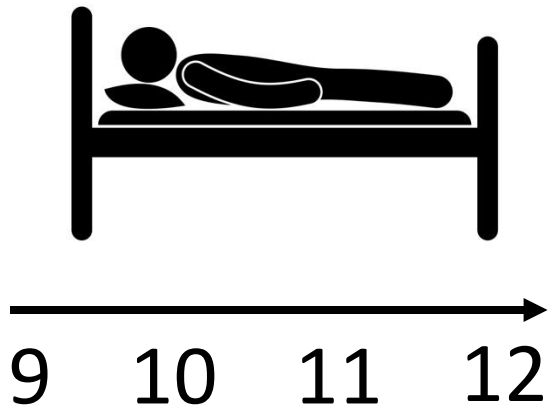
Hydration



# High glucose after exercise

- If glucose is high post exercise first rehydrate and then recheck glucose.

# Preventing hypoglycaemia overnight – bedtime snacks



Hours after exercise

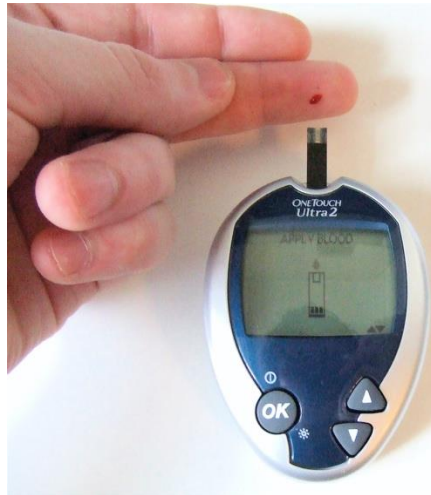
If blood glucose 7-10 mmol/l before bed then try protein and carbohydrate snack (30 grams carb + 15 gram protein).

If blood glucose <7 before bed, as well as snack may need to make reduction in background insulin/basal rate of 10% or

HCL tends to manage if not can go to temp basal or higher glucose target.



# Using exercise to manage glucose post exercise

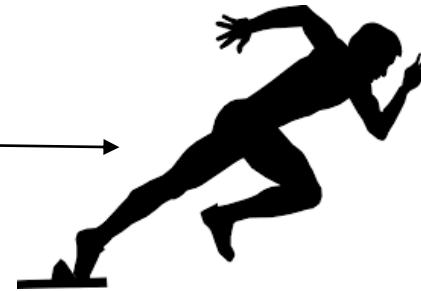


**Glucose >10**



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

**Glucose <4**

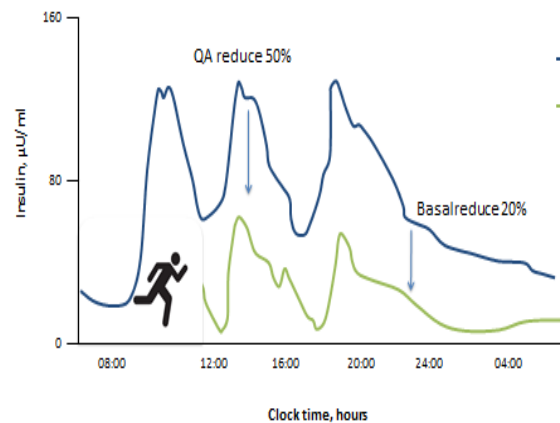


**10 sec sprint**  
**Raises by 2-4 mmol**  
**Protects from hypo for**  
**30-40 minutes**



# Three options for managing glucose around exercise - ICE

**I**nulin – how much on board / how do you alter it



50% of normal quick acting with meal prior to exercise if exercising within 2 hours of meal

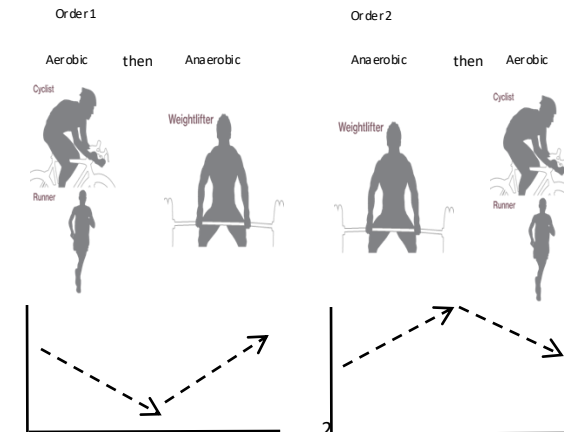
50% of normal quick acting insulin for first 2 meals/snacks after

20% reduction night time background insulin if exercise after 4 pm or longer than 2 hours

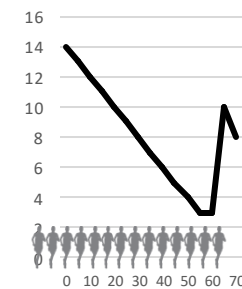
**C**arbohydrate for exercise

Situation	General CHO Recommendations
Habitual diet	Light training 3-5 g/kg/d
	Mod exercise 5-7 g/kg/d
	High (1-3h/d) 6-10 g/kg/d
	Very high (>4-5h/d) 8-12 g/kg/d
Pre event meal eaten 1- 4 hours pre exercise	A minimum of 1-4g/kg BW for exercise > 1 h duration Consider Low GI choices
During activity (> 1 hour)	30-60 g/h Up to 90 g/h
Ultra Endurance (>3 hours)	Consider High GI choices
Recovery	1 -1.2g/kg during the first hour

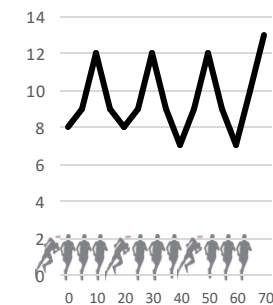
**E**xercise type and intensity



Continuous exercise



Continuous exercise + sprints



Where do I get  
further  
information?



# Further information

Diabetes team

Websites

- [https:// EXTOD.org](https://EXTOD.org) – can also find out about research here
- [https:// Runsweet.com](https://Runsweet.com)
- <https://theglucoseneverlies.com>

Look out for

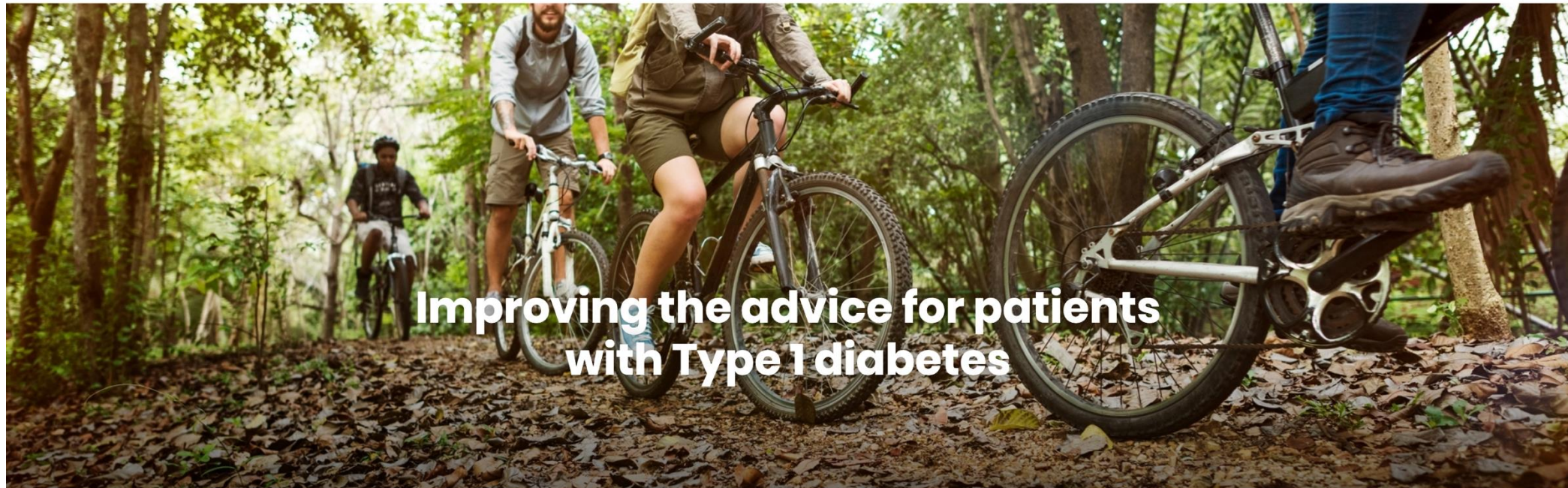
- EXTOD sport weekend
- EXTOD patient conference
- EXTOD education coming to your area.

Rob Andrews email – [R.C.Andrews@exeter.ac.uk](mailto:R.C.Andrews@exeter.ac.uk)

# Further information – [www.EXTOD.org](http://www.EXTOD.org)



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**Improving the advice for patients  
with Type 1 diabetes**

**Managing glucose level through exercise**

Email - [r.c.andrews@exeter.ac.uk](mailto:r.c.andrews@exeter.ac.uk)



ANY  
QUESTIONS?

