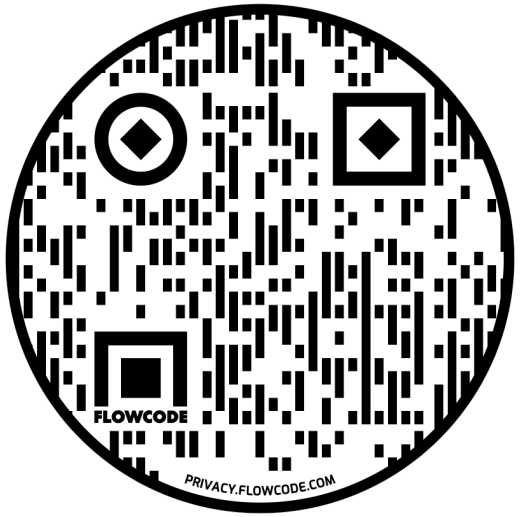
APS Exercise Calculators

Birmingham Women's and Children's NHS Foundation Trust

Watch this training video

https://screencast-o-matic.com/watch/cYXFDyLoc6



Mr. John Pemberton

John works at the Birmingham Women's Children's Hospital as a Diabetes Specialist Dietitian, helping look after 300 children with Type 1 Diabetes, and 25 Children with Type 2 Diabetes. The bulk of his work involves empowering and educating Children and Young People and their families to self-manage diabetes. His current interests include the effective use of new technology (APS, CGM, pumps), re-establishing foundational principles (three balanced meals, regular activity and insulin timings) and how expectations drive change. He created the "CGM Academy" that teaches Dynamic Glucose Management in 2020, implemented a novel high HbA1c pathway in 2019, co-authored the ACDC CGM guidance in 2018, and implemented the KISS system for giving extra insulin for high fat and protein meals in 2017. His niche lies in developing easy to use interactive PDF tools that put the theory into practice. His most important jobs are being a top dad to Grace and Jude and trying to be a half decent husband to Dani.

Before getting the calculators

Birmingham Women's and Children's NHS Foundation Trust

- You must have watched the APS Guide:
  - https://screencast-o-matic.com/watch/cYXIIKMKso
- You must watch this video to be able to answer the competency
- You must have got competency for the type 1 DEC without APS:
  - https://forms.gle/VzgR2dn6CCuP14AQA
- You must be a diabetes health care professional
- You must score 9/10 on the competency
  - https://forms.gle/c1xMp6M5GymMoAuV6
- You must not share the calculators

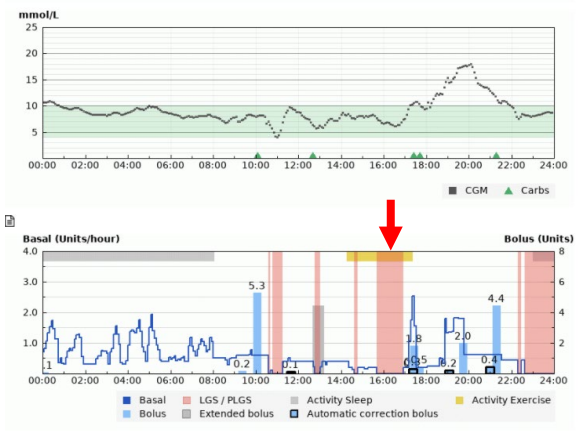
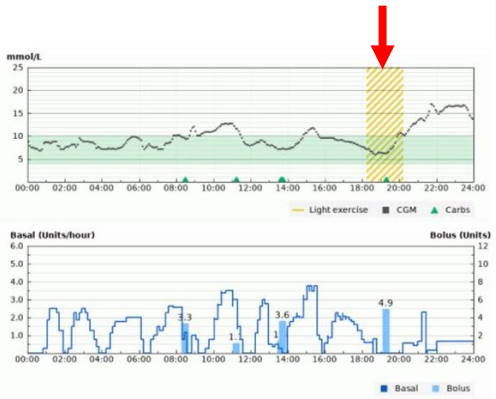
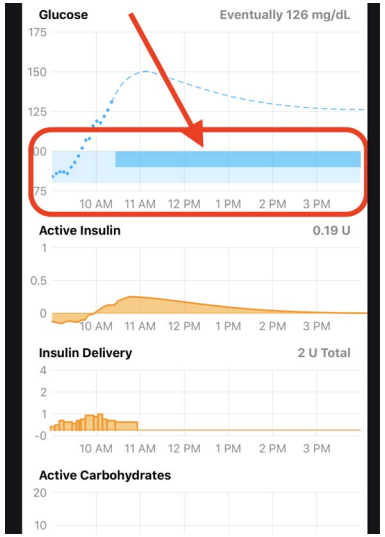
The different systems with CE Mark

Birmingham Women's and Children's NHS Foundation Trust

Variable	670G – Auto Mode	780G – SmartGuard	T-Slim Control IQ	CamAPS FX
Where to get training?	https://hcp.medtronic-diabetes.co.uk/	https://hcp.medtronic-diabetes.co.uk/	https://www.airliquidehealthcare.co.uk/sites/homecare_uk/files/Control-IQ-Training-for-Clinical-Professionals-Module/story.html	https://camdiab.cdep.org.uk/
What need	670G pump & consumables Guardian™ Sensor 3 Guardian™ 3 Link Transmitter Carelink account linked to centre Ascensia Contour Next Link 2.4	780G pump & consumables Guardian™ Sensor 3 Guardian™ 3 Link Transmitter (BLE) Carelink account linked to centre Roche Accu-Chek Guide Link Meter Patient: MiniMed Mobile APP Care partners: Carelink Connect APP	T-Slim x 2 pump & consumables Dexcom G6 sensor Dexcom G6 transmitter Control IQ algorithm Company started or HCP (Certification available) Diasend account linked to centre - optional	Dana Pump & consumables Dexcom G6 sensor Dexcom G6 transmitter Android phone CamAPS APP & paid subscription Diasend account linked to centre Certified trainers with number
CE Mark	7 years + 8u TDD NovoRapid, Humalog	7 years + 8u TDD NovoRapid, Humalog	6 years + Weight 25-140kg 10-100u TDD No pregnancy (Pump & Dexcom ok) NovoRapid & Humalog	1 year + Weight 10-300kg 5-300u TDD NovoRapid, Humalog, Apidra Dexcom licenced from 2yrs so clinical decision if using 1-2yrs NovoRapid, Humalog, Apidra, FiAsp

What settings will help for exercise?

Birmingham Women's and Children's NHS Foundation Trust

Variable	670G & 780G	T-Slim Control IQ	CamAPS FX	DIY
Exercise	**Temp target 8.3mmol/L** Effective if exercise more than 90 minutes after eating if Active insulin is set at 2-3 hours Temp target must be set 90 minutes before activity. Effective for preventing hypos after activity by extending up to 6 hours after. Will need to reduce carbs (25-50%) entered into bolus wizard if meal within 90 minutes of exercise due to little or no basal running as IOB is high. 	**Control IQ Exercise Target 7.8-8.9mmol/L.** Can set **insulin setting profiles** with basal rates, ICR and ISF relaxed e.g. -25% (mixed) & -50% (aerobic). Set Exercise Target and insulin profile 90 minutes before activity. Effective for preventing hypos after activity by extending up to 6 hours after. As shows below: 90 minutes after eating, basal is running normally as recognises carbs on board, therefore more chance of Exercise target, change of insulin settings profile and Control IQ preventing hypo. 	**Ease Off:** No insulin delivered below 7.7mmol/L, insulin sensitivity increased by 50% in the algorithm, target increased by 2.5mmol/L (5.8 to 8.2mmol/L) Set 90 minutes before activity. Effective for preventing hypos after activity by extending up to 6 hours after. As shows below: 90 minutes after eating, basal is running normally as the algorithm recognises carbs on board, therefore more chance of "Ease off" preventing hypo. May still need less carbs (25%) entered into bolus calculator if exercise within 90 mins of eating. 	**DIY: user set (3.5 – 14.0 mmol/L)** Can set **insulin setting profiles** with basal rates, ICR and ISF relaxed e.g. 25% (mixed) & 50% (aerobic). Set Exercise Target and insulin profile 90 minutes before activity. Effective for preventing hypos after activity by extending up to 6 hours after. 

Must drip feed carbs during exercise as needed (same for DIY)?

Birmingham Women's and Children's NHS Foundation Trust

Variable	670G & 780G	T-Slim Control IQ	CamAPS FX
Preventing highs with basal increases	If Algorithm predicts above the Temp target level the basal insulin is increased **= Hypo risk**	If Algorithm predicts above the Exercise target level the basal insulin is increased **= Hypo risk**	**I**f Algorithm predicts above the "Ease off" target level the extended bolus is increased **= Hypo risk**
Preventing highs with auto corrections	If 780G Algorithm predicts above the Temp target level and going high fast autocorrection no longer applied **= hypo protection**	If Algorithm predicts above the Temp target level and going above 10.0mmol/L an auto correction is delivered = **Big hypo risk**	If Algorithm predicts above the "Ease off" level and going high fast a more aggressive extended bolus is delivered = **Big hypo risk**
Solution: Small amount carbs just before & during exercise – cap at 60kg as cannot absorb more than 1g/min of glucose	Drip feed glucose every 20 minutes. Start at 0.5g/kg/hr and vary according to CGM trend arrows. E.g. 30kg = 4g per 20 minutes	Drip feed glucose every 20 minutes. Start at 0.5g/kg/hr and vary according to CGM trend arrows. E.g. 50kg = 8g per 20 minutes	Drip feed glucose every 20 minutes. Start at 0.5g/kg/hr and vary according to CGM trend arrows. E.g. 60kg = 10g per 20 minutes

Carbohydrate just before & during exercise Moser et al 2020

Birmingham Women's and Children's NHS Foundation Trust

20 minutes before

Pre-exercise sensor glucose for different groups in T1D			Trend arrow	Action	
Ex 2 and/or low hypo risk	Ex 1 and/or moderate hypo risk	Ex 0 and/or high hypo risk	Direction	Increase in sensor glucose expected	Decrease in sensor glucose expected
>15.0 mmol/l (>270 mg/dl) AND >1.5 mmol/l blood ketones			↑↗→↘↓	No Ex, Insulin correction	
>15.0 mmol/l (>270 mg/dl) AND ≤1.5 mmol/l blood ketones			↑↗	Consider insulin correction[a], Can start AE	Consider insulin correction[a], Can start all Ex
			→	Consider insulin correction[a], Can start AE	Can start all Ex
			↘↓	Can start all Ex	
10.1–15.0 mmol/l (181–270 mg/dl)	11.1–15.0 mmol/l (199–270 mg/dl)	12.1–15.0 mmol/l (217–270 mg/dl)	↑↗	Can start AE	Can start all Ex
			→	Can start all Ex	
			↘↓		
7.0–10.0 mmol/l (126–180 mg/dl)	8.0–11.0 mmol/l (145–198 mg/dl)	9.0–12.0 mmol/l (162–216 mg/dl)	↑↗	Can start all Ex	
			→		
			↘↓	~5 g CHO (0.2 g/kg), Can start all Ex	~10 g CHO (0.3 g/kg), Can start all Ex
5.0–6.9 mmol/l (90–125 mg/dl)	5.0–7.9 mmol/l (90–144 mg/dl)	5.0–8.9 mmol/l (90–161 mg/dl	↑↗	Can start all Ex	~5 g CHO (0.2 g/kg), Can start all Ex
			→	~5 g CHO (0.2 g/kg), Can start all Ex	~10 g CHO (0.3 g/kg), Can start all Ex
			↘	~10 g CHO (0.3 g/kg), Delay all Ex[b]	~15 g CHO (0.4 g/kg), Delay all Ex[b]
			↓	Individual amount CHO ingestion, Delay all Ex[b]	
<5.0 mmol/l (<90 mg/dl)			Individual amount CHO ingestion, Delay all Ex[b]		

Moser at al (2020)

Every 15-20 minutes during

Pre-exercise sensor glucose for different groups in T1D			Trend arrow	Action	
Ex 2 and/or low hypo risk	Ex 1 and/or moderate hypo risk	Ex 0 and/or high hypo risk	Direction	Increase in sensor glucose expected	Decrease in sensor glucose expected
>15.0 mmol/l (>270 mg/dl) AND >1.5 mmol/l blood ketones			↑↗→↘↓	No Ex, Insulin correction	
>15.0 mmol/l (>270 mg/dl) AND ≤1.5 mmol/l blood ketones			↑↗	Consider insulin correction[a], Can start AE	Consider insulin correction[a], Can start all Ex
			→	Consider insulin correction[a], Can start AE	Can start all Ex
			↘↓	Can start all Ex	
10.1–15.0 mmol/l (181–270 mg/dl)	11.1–15.0 mmol/l (199–270 mg/dl)	12.1–15.0 mmol/l (217–270 mg/dl)	↑↗	Can start AE	Can start all Ex
			→	Can start all Ex	
			↘↓		
7.0–10.0 mmol/l (126–180 mg/dl)	8.0–11.0 mmol/l (145–198 mg/dl)	9.0–12.0 mmol/l (162–216 mg/dl)	↑↗	Can start all Ex	
			→		
			↘↓	~5 g CHO (0.2 g/kg), Can start all Ex	~10 g CHO (0.3 g/kg), Can start all Ex
5.0–6.9 mmol/l (90–125 mg/dl)	5.0–7.9 mmol/l (90–144 mg/dl)	5.0–8.9 mmol/l (90–161 mg/dl	↑↗	Can start all Ex	~5 g CHO (0.2 g/kg), Can start all Ex
			→	~5 g CHO (0.2 g/kg), Can start all Ex	~10 g CHO (0.3 g/kg), Can start all Ex
			↘	~10 g CHO (0.3 g/kg), Delay all Ex[b]	~15 g CHO (0.4 g/kg), Delay all Ex[b]
			↓	Individual amount CHO ingestion, Delay all Ex[b]	
<5.0 mmol/l (<90 mg/dl)			Individual amount CHO ingestion, Delay all Ex[b]		

Moser at al (2020)

Carbs 20 min before & every 20 min during

Birmingham Women's and Children's NHS Foundation Trust

Sensor glucose Levels	Trend arrow & action to take	Grams carb g/kg/20min (60min) - Aerobic	Grams carb g/kg/20min (60min) - Mixed	Grams carb g/kg/20min (60min) - Anaerobic
<4.0mmol/L	Treat hypo, re-check & follow below guidance	0.5/kg	0.5/kg	0.5/kg
4.0-4.9 mmol/L	↑↑	0.5 (1.5)	0.45 (1.35)	0.4 (1.2)
	↑	0.4 (1.2)	0.35 (1.05)	0.3 (0.9)
	→	0.3 (0.9)	0.25 (0.75)	0.2 (0.6)
	↓	0.2 (0.6)	0.15 (0.45)	0.1 (0.3)
	↓↓	0.1 (0.3)	0.05 (0.15)	0 (0)
E2: 5.0-6.9 mmol/L E1: 5.0-7.9 mmol/L E0: 5.0-8.9 mmol/L	↑↑	0.5 (1.5)	0.45 (1.35)	0.4 (1.2)
	↑	0.4 (1.2)	0.35 (1.05)	0.3 (0.9)
	→	0.3 (0.9)	0.25 (0.75)	0.2 (0.6)
	↓↓	0.2(0.6)	0.1 (0.3)	0 (0)
E2: 7.0–10.0mmol/L E1: 8.0-11.0mmol/L E0: 8.0-12.0mmol/L	↑↑	0.3 (0.9)	0.25 (0.75)	0.2 (0.6)
	→	0 (0)	0 (0)	0 (0)
	↓↓	0 (0)	0 (0)	0 (0)
13.9 mmol/L	All Arrows	0 (0)	0.0 (0)	0.0 (0)
>13.9 mmol/L & ketones <0.5mmol/L	→	Ok to exercise: No carbohydrate needed for 20 minutes		
	↓↓	Ok to exercise: No carbohydrate needed for 20 minutes, may need 50% of correction dose		
ketones >0.5mmol/L	All Arrows	No exercise: Requires corrective dose of insulin to get ketones less than 0.6mmol/l before starting exercise		

Capped at 60kg due to glucose absorption limit of 1g/min for glucose and 1.5g/kg for mixed fast acting carb sources – Jeukendrup (2014) *Sports Med* **44,** 25–33

ARTICLE IN PRESS
Can J Diabetes xxx (2020) 1–10
Contents lists available at ScienceDirect
Canadian Journal of Diabetes
journal homepage: www.canadianjournalofdiabetes.com
DIABETES CANADA
CJD
ELSEVIER

Review

Glucose Control During Physical Activity and Exercise Using Closed Loop Technology in Adults and Adolescents with Type 1 Diabetes

Dessi P. Zaharieva PhD [a,*]; Laurel H. Messer RN, MPH, CDE [b]; Barbora Paldus MBBS [c]; David N. O'Neal MD [c,d]; David M. Maahs MD, PhD [a,e]; Michael C. Riddell PhD [f,g]

[a] Division of Endocrinology, Department of Pediatrics, Stanford University School of Medicine, Stanford, California, United States

Table 3
Open vs closed loop diabetes management strategies for exercise

	Open loop	Closed loop
Contraindications	• Recent severe hypoglycemia (i.e. loss of consciousness, seizure or inability to self-treat) • Significant hyperglycemia (>15.0 mmol/L) • Ketones (≥1.5 mmol/L)	
Before exercise meal bolus	• Meal bolus >3 h before exercise: Usual bolus with or without correction • Meal bolus <1–3 h before exercise: Reduce bolus by: 25% for light exercise 50% for moderate aerobic exercise 75% for heavy aerobic exercise	
Before exercise basal adjustment	50% to 80% reduction 90 min before exercise and/or Pump suspension at exercise start	Exercise target 1–2 h earlier and/or If pump disconnected, should be suspended
Before exercise CHO (if glucose <7.0 mmol/L)	• <5.0 mmol/L: 10–30 g CHO • 5.0–6.9 mmol/L: 10 g CHO (aerobic)	• As per open loop * • Give <10 min before exercise
Before exercise CHO (if glucose 7.0–10.0 mmol/L)	0 g CHO	
Before exercise CHO (if glucose >10.0 mmol/L)	0 g CHO • 10.1–15.0 mmol/L: Start exercise (aerobic) Ketones <0.6 mmol/L (mild to moderate exercise) Ketones 0.6–1.4 mmol/L (light/short-duration exercise)	
Before exercise meal bolus	0% to 50% bolus reduction	Usual bolus/slight reduction (<25%)
Before exercise basal adjustment	20% basal reduction for 6 h at bedtime	Exercise target off †

CHO, carbohydrate; *h*, hours; *min*, minutes.
Note: Modified from Riddell et al (13).
* Denotes less CHO may be required with closed loop (~10 to 20 g).
† Denotes that, if patients are at high risk of hypoglycemia after exercise (e.g. prolonged aerobic or mixed activity), consider continuing exercise target for several hours after activity or overnight.

Control IQ Calculator Algorithm

NHS
Birmingham Women's and Children's
NHS Foundation Trust

		Before exercise			During exercise	After exercise	
		Meal insulin: carbohydrate reduction into Bolus Calculator		Control IQ (Manual Mode) Target (basal)	Carbohydrate 20 mins before, every 20 mins during	**Control IQ ON**	
Exercise type	Plan execution	Within 90mins of exercise, reduction of carbohydrate to enter into Bolus Calculator: Closed Loop (Open Loop)	More than 90 minutes before exercise: Closed Loop (Open Loop)	Target to activate 90 minutes before exercise (basal change 90 minutes before activity)	See carbs chart for glucose level and trend arrows	**Control IQ ON** If eating within 90 minutes after exercise:	**Start Control IQ ON** If not eating after exercise Set Target
Aerobic	Went low first time	-75% carbs (-75% carbs)	Enter all carbs (Enter all carbs)	Exercise Target 90 minutes before exercise (-75% basal rate 90 minutes before exercise)		-50% carbs	Exercise Target for 6 hours
	Starting plan	-50% carbs (-50% carbs)	Enter all carbs (Enter all carbs)	Exercise Target 90 minutes before exercise (-50% basal rate 90 minutes before exercise)		-25% carbs	Normal Target
	Went high first time	-25% carbs (-25% carbs)	Enter all carbs (Enter all carbs)	Exercise Target 90 minutes before exercise (-25% basal rate 90 minutes before exercise)		Enter all carbs	Normal Target
Mixed	Went low first time	-50% carbs (-50% carbs)	Enter all carbs (Enter all carbs)	Exercise Target 90 minutes before exercise (-50% basal rate 90 minutes before exercise)		-50% carbs	Exercise Target for 6 hours
	Starting plan	-25% carbs (-25% carbs)	Enter all carbs (Enter all carbs)	Exercise Target 90 minutes before exercise (-25% basal rate 90 minutes before exercise)		-25% carbs	Normal Target
	Went high first time	Enter all carbs (No change)	Enter all carbs (Enter all carbs)	Normal Target (No basal rate change)		Enter all carbs	Normal Target
Anaerobic	Went low first time	-25% carbs (-25% carbs)	Enter all carbs (Enter all carbs)	Exercise Target 90 minutes before exercise (-25% basal rate 90 minutes before exercise)		-25% carbs	Exercise Target for 6 hours
	Starting plan	Enter all carbs (No change)	Enter all carbs (Enter all carbs)	Normal Target (No basal rate change)		Enter all carbs	Normal Target
	Went high first time	Enter full carbs and small bolus 15 mins pre-exercise (Enter full carbs and small bolus 15 mins pre-exercise)	Enter all carbs (Enter all carbs)	Normal target and small bolus 15 mins pre-exercise (No basal change and small bolus 15 mins pre-exercise)		Enter all carbs	Normal Target

Control IQ Example

NHS
Birmingham Women's and Children's
NHS Foundation Trust

T-Slim Control IQ Type 1 DEC (Diabetes Exercise Calculator)

I agree: I am a qualified diabetes professional. I will not give this to a patient. I will only use the calculator after watching this **video** and achieving **competency**. I will not pass the calculator on to any other person. I will only use the calculator with Adobe Acrobat Reader? Yes

- Open in Adobe Acrobat Reader (click to get for free): Computer Apple Android
- For a new plan make sure the answers to both review questions read "Stayed in target"

1. What's your name? Joe Bloggs

2. What activity are you doing and what time are you doing it? Football

3. Control IQ or manual mode before & during exercise? Control IQ

4. How many minutes before exercise are you eating and giving insulin? 180

5. How many minutes are you exercising for? 60

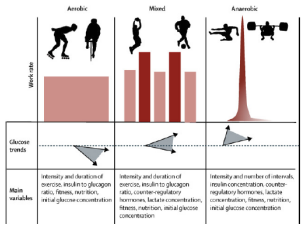
6. What is your weight in kilograms (kg)? 80

7. What is your exercise hypoglycaemia risk? Low (All of: 1. Exercise more than 2 times a week, 2. TBR less than 4%, 3. Hypo aware

8. What type of activity are you doing (see pictures)? Mixed

9. What glucose units does your device use? mmol/L

10. At what glucose & ketone level should you stop exercise? ≥14.0mmol/L (250mg/dL) & ≥0.6mmol/L



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

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

Adapting the plan after trying the first trial:

Glucose level during exercise? Stayed in target

Glucose level after exercise? Stayed in target

Disclaimer

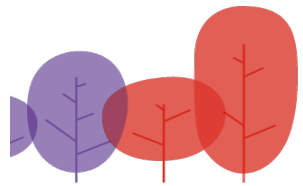
- Plans must be made by a qualified diabetes professional
- Always consult a qualified diabetes professional before trying or adapting a plan

NHS
Birmingham Women's and Children's
NHS Foundation Trust

Joe Bloggs

Activity How long for How long after meal	Meal before Exercise Target or Basal before	During Activity	After activity: Control IQ ON Choose 1 if eating after Choose 2 if not eating after
Football for 60 minutes starting 180 minutes after last meal	Enter all carbs into the Bolus Calculator Exercise Target 90 minutes before exercise	See the chart below for exercise action required for: 1. 20 mins before 2. Just before 3. Every 20 mins For safety: set low alert at 5.6mmol/L	1. Eating after: Reduce carbs entered into the Bolus Calculator by 25% & set a Normal Target 2. Not eating after: Set Normal Target

Sensor glucose Levels	Trend arrow & action to take	Carbohydrate grams needed for 20 mins		Dextrose (3g)	Lucozade
<4.0mmol/L Check BG	<3.0mmol/L: NO exercise	30	Treat & re-check in 20 minutes	10	333
4.0-4.9 mmol/L	↓ ↓↓	27	& delay exercise for 20 minutes	9	300
	↘	21	& delay exercise for 20 minutes	7	233
	→	15	& delay exercise for 20 minutes	5	167
	↗	9	& delay exercise for 20 minutes	3	100
	↑ ↑↑	3	& delay exercise for 20 minutes	1	33
5.0-6.9 mmol/L	↓ ↓ ↓	27	& start exercise check in 20 mins	9	300
	↘	21	& start exercise check in 20 mins	7	233
	→	15	& start exercise check in 20 mins	5	167
	↗ ↑ ↑↑	6	& start exercise check in 20 mins	2	67
7.0-10.0 mmol/L	↘ ↓ ↓↓	15	& start exercise check in 20 mins	5	167
	→	0	& start exercise check in 20 mins		
	↗ ↑ ↑↑	0	& start exercise check in 20 mins		
10.1-13.9 mmol/L	All Arrows	0	& start exercise check in 20 mins		
≥14.0mmol/L (Check BG) & ketones <0.6mmol/L	→ ↘ ↓ ↓↓	OK to exercise: No carbohydrate for 20 minutes			
	↗ ↑ ↑↑	OK to exercise: Consider 50% of correction dose before starting			
≥14.0mmol/L & ketones ≥0.6mmol/L	All Arrows	No exercise: Correction dose & ketones <0.6mmol/L before starting exercise			



670G & 780G Calculator Algorithm

Birmingham Women's and Children's NHS Foundation Trust

		Before exercise			During exercise	After exercise	
		Meal insulin: Carbohydrate reduction into Bolus Wizard		Auto Mode (Manual Mode) Target (basal)	Carbohydrate 20 mins before, every 20 mins during	**Auto Mode ON**	
Exercise type	Plan execution	Within 90mins of exercise, reduction of carbohydrate to enter into Bolus Wizard: Auto Mode (Manual Mode)	More than 90 minutes before exercise: Auto Mode (Manual Mode)	Target to activate 90 minutes before exercise (basal to change 90 minutes before exercise)	See carbs chart for glucose level and trend arrows	**Auto Mode ON** If eating after exercise: Reduction of carbohydrate to enter into Bolus Wizard	**Auto Mode ON** If not eating after exercise Set Target
Aerobic	Went low first time	-75% carbs (-75% carbs)	Enter all carbs (Enter all carbs)	Temp Target 90 minutes before exercise (-75% basal rate 90 minutes before exercise)		-75% carbs	Temp target for 6 hours
	Starting plan	-50% carbs (-50% carbs)	Enter all carbs (Enter all carbs)	Temp Target 90 minutes before exercise (-50% basal rate 90 minutes before exercise)		-50% carbs	Normal Target
	Went high first time	-25% carbs (-25% carbs)	Enter all carbs (Enter all carbs)	No Temp Target (-25% basal rate 90 minutes before exercise)		-25% carbs	Normal Target
Mixed	Went low first time	-50% carbs (-50% carbs)	Enter all carbs (Enter all carbs)	Temp Target 90 minutes before exercise (-50% basal rate 90 minutes before exercise)		-75% carbs	Temp target for 6 hours
	Starting plan	-25% carbs (-25% carbs)	Enter all carbs (Enter all carbs)	Temp Target 90 minutes before exercise (-25% basal rate 90 minutes before exercise)		-50% carbs	Normal Target
	Went high first time	Enter all carbs (Enter all carbs)	Enter all carbs (Enter all carbs)	No Temp Target (No basal change)		-25% carbs	Normal Target
Anaerobic	Went low first time	-25% carbs (-25% carbs)	Enter all carbs (Enter all carbs)	Temp Target 90 minutes before exercise (-25% basal rate 90 minutes before exercise)		50% carbs	Temp target for 6 hours
	Starting plan	Enter all carbs (Enter all carbs)	Enter all carbs (Enter all carbs)	No Temp Target (No basal change)		-25% carbs	Normal Target
	Went high first time	Enter all carbs and small bolus 15 mins pre-exercise (Enter all carbs and small bolus 15 mins pre-exercise)	Enter all carbs (Enter all carbs)	No Temp target and small bolus 15 mins pre-exercise (No basal change and small bolus 15 mins pre-exercise)		Enter all carbs	Normal Target

670G & 780G Example

NHS
Birmingham Women's and Children's
NHS Foundation Trust

Medtronic 670G & 780G Type 1 DEC (Diabetes Exercise Calculator)

I agree: I am a qualified diabetes professional. I will not give this to a patient. I will only use the calculator after watching this **video** and achieving **competency**. I will not pass the calculator on to any other person. I will only use the calculator with Adobe Acrobat Reader? Yes

- Open in Adobe Acrobat Reader (click to get for free): **Computer** **Apple** **Android**
- For a new plan make sure the answers to both review questions read "Stayed in target"

1. What's your name?
Joe Bloggs

2. What activity are you doing and what time are you doing it?
Running

3. Auto or Manual mode before & during exercise?
Auto Mode

4. How many minutes before exercise are you eating and giving insulin? 60

5. How many minutes are you exercising for? 45

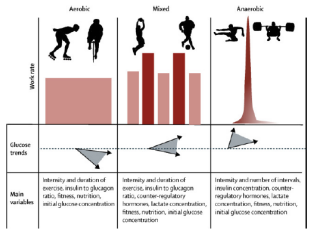
6. What is your weight in kilograms (kg)? 50

7. What is your exercise hypoglycaemia risk?
Low (All of: 1. Exercise more than 2 times a week, 2. TBR less than 4%, 3. Hypo aware

8. What type of activity are you doing (see pictures)?
Aerobic

9. What glucose units does your device use?
mmol/L

10. At what glucose & ketone level should you stop exercise?
≥14.0mmol/L (250mg/dL) & ≥0.6mmol/L



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

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

Adapting the plan after trying the first trial:

Glucose level during exercise?
Stayed in target

Glucose level after exercise?
Stayed in target

Disclaimer

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

NHS
Birmingham Women's and Children's
NHS Foundation Trust

Joe Bloggs

Activity How long for How long after meal	Meal before Temp Target or Basal before	During Activity	After activity: Auto Mode ON Choose 1 if eating after Choose 2 if not eating after
Running for 45 minutes starting 60 minutes after last meal	Reduce carbs entered into Bolus Wizard by 50% Temp Target 90 minutes before exercise	See the chart below for exercise action required for: 1. 20 mins before 2. Just before 3. Every 20 mins For safety: set low alert at 5.6mmol/L	1. Eating after: Reduce carbs entered by 50% & set a Normal Target 2. Not eating after: Set Normal Target

Sensor glucose Levels	Trend arrow & action to take	Carbohydrate grams needed for 20 mins	Dextrose (3g)	Lucozade
<4.0mmol/L Check BG	<3.0mmol/L: NO exercise	25 Treat & re-check in 20 minutes	8	278
4.0-4.9 mmol/L	↓↓ ↓↓↓	25 & delay exercise for 20 minutes	8	278
	↓	20 & delay exercise for 20 minutes	7	222
		15 & delay exercise for 20 minutes	5	167
	↑	10 & delay exercise for 20 minutes	3	111
	↑↑ ↑↑↑	5 & delay exercise for 20 minutes	2	56
5.0-6.9 mmol/L	↓↓ ↓↓↓	25 & start exercise check in 20 mins	8	278
	↓	20 & start exercise check in 20 mins	7	222
		15 & start exercise check in 20 mins	5	167
	↑ ↑↑ ↑↑↑	10 & start exercise check in 20 mins	3	111
7.0-10.0 mmol/L	↓ ↓↓ ↓↓↓	15 & start exercise check in 20 mins	5	167
		0 & start exercise check in 20 mins		
	↑ ↑↑ ↑↑↑	0 & start exercise check in 20 mins		
10.1-13.9 mmol/L	All Arrows	0 & start exercise check in 20 mins		
≥14.0mmol/L (Check BG) & ketones <0.6mmol/L	↓ ↓↓ ↓↓↓	OK to exercise: No carbohydrate for 20 minutes		
	↑ ↑↑ ↑↑↑	OK to exercise: Consider 50% of correction dose before starting		
≥14.0mmol/L & ketones ≥0.6mmol/L	All Arrows	No exercise: Correction dose & ketones <0.6mmol/L before starting exercise		

CAMAPS FX Calculator Algorithm

Birmingham Women's and Children's NHS Foundation Trust

		Before exercise			During exercise	After exercise	
		Meal insulin: carbohydrate reduction into Bolus Calculator		Auto Mode (Manual Mode) Target (basal)	Carbohydrate 20 mins before, every 20 mins during	**Auto Mode ON**	
Exercise type	Plan execution	Within 90mins of exercise, reduction of carbohydrate to enter into Bolus Calculator: Auto Mode (Manual mode)	More than 90 minutes before exercise: Closed Loop (Open Loop)	Target or basal to activate 90 minutes before exercise: Closed Loop (Open Loop)	See carbs chart for glucose level and trend arrows	**Auto Mode ON** If eating after exercise: Reduction of carbohydrate to enter into Bolus Wizard	**Auto Mode ON** If not eating after exercise Set Target
Aerobic	Went low first time	-50% carbs (-75% carbs)	Enter all carbs (Enter all carbs)	Ease Off 90 minutes before exercise (-75% basal rate 90 minutes before exercise)		-50% carbs	Ease off for 6 hours
	Starting plan	-25% carbs (-50% carbs)	Enter all carbs (Enter all carbs)	Ease Off 90 minutes before exercise (-50% basal rate 90 minutes before exercise)		-25% carbs	Normal Target
	Went high first time	No change (-25% carbs)	Enter all carbs (Enter all carbs)	Ease Off 90 minutes before exercise (-25% basal rate 90 minutes before exercise)		No change	Boost for 3 hours
Mixed	Went low first time	-25% carbs (-50% carbs)	Enter all carbs (Enter all carbs)	Ease Off 90 minutes before exercise (-50% basal rate 90 minutes before exercise)		-50% carbs	Ease off for 6 hours
	Starting plan	Enter all carbs (-25% carbs)	Enter all carbs (Enter all carbs)	Ease Off 90 minutes before exercise (-25% basal rate 90 minutes before exercise)		-25% carbs	Normal Target
	Went high first time	Enter all carbs (Enter all carbs)	Enter all carbs (Enter all carbs)	Normal Target (No basal rate change)		No change	Boost for 3 hours
Anaerobic	Went low first time	-25% carbs (-25% carbs)	Enter all carbs (Enter all carbs)	Ease Off 90 minutes before exercise (-25% basal rate 90 minutes before exercise)		25% carbs	Ease off for 6 hours
	Starting plan	Enter all carbs (Enter all carbs)	Enter all carbs (Enter all carbs)	Normal Target (No basal rate change)		No change	Normal Target
	Went high first time	Enter full carbs and small bolus 15 mins pre-exercise (No change)	Enter all carbs (Enter all carbs)	Normal target and small bolus 15 mins pre-exercise (No basal change and small bolus 15 mins pre-exercise)		No change	Boost for 3 hours

CAMAPS FX Example

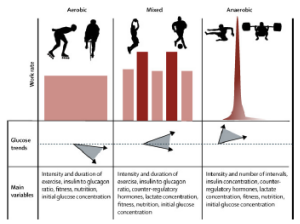
Birmingham Women's and Children's NHS Foundation Trust

CAMAPS FX Type 1 DEC (Diabetes Exercise Calculator)

I agree: I am a qualified diabetes professional. I will not give this to a patient. I will only use the calculator after watching this **video** and achieving **competency**. I will not pass the calculator on to any other person. I will only use the calculator with Adobe Acrobat Reader? Yes

- Open in Adobe Acrobat Reader (click to get for free): Computer Apple Android
- For a new plan make sure the answers to both review questions read "Stayed in target"

1. What's your name? Joe Bloggs
2. What activity are you doing and what time are you doing it? Cycling 18:00
3. Auto or manual mode before & during exercise? Auto Mode
4. How many minutes before exercise are you eating and giving insulin? 45
5. How many minutes are you exercising for? 60
6. What is your weight in kilograms (kg)? 60
7. What is your exercise hypoglycaemia risk? Low (All of: 1. Exercise more than 2 times a week, 2. TBR less than 4%, 3. Hypo aware
8. What type of activity are you doing (see pictures)? Aerobic
9. What glucose units does your device use? mmol/L
10. At what glucose & ketone level should you stop exercise? ≥14.0mmol/L (250mg/dL) & ≥0.6mmol/L



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

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

Adapting the plan after trying the first trial:

Glucose level during exercise? Stayed in target

Glucose level after exercise? Stayed in target

Disclaimer

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

Birmingham Women's and Children's NHS Foundation Trust

Joe Bloggs

Activity How long for How long after meal	Meal before Ease off or Basal before	During Activity	After activity: Auto Mode ON Choose 1 if eating after Choose 2 if not eating after
Cycling 18:00 for 60 minutes starting 45 minutes after last meal	Reduce carbs entered into Bolus Calculator by 25% Ease Off 90 minutes before exercise	See the chart below for exercise action required for: 1. 20 mins before 2. Just before 3. Every 20 mins For safety: set low alert at 5.6mmol/L	1. Eating after: Reduce carbs entered by 25% & set a Normal Target 2. Not eating after: Set Normal Target

Sensor glucose Levels	Trend arrow & action to take	Carbohydrate grams needed for 20 mins	Dextrose (3g	Lucozade
<4.0mmol/L Check BG	<3.0mmol/L: NO exercise	30 Treat & re-check in 20 minutes	10	333
4.0-4.9 mmol/L	↓ ↓↓	30 & delay exercise for 20 minutes	10	333
	↘	24 & delay exercise for 20 minutes	8	267
	→	18 & delay exercise for 20 minutes	6	200
	↗	12 & delay exercise for 20 minutes	4	133
	↑ ↑↑	6 & delay exercise for 20 minutes	2	67
5.0-6.9 mmol/L	↓ ↓ ↓	30 & start exercise check in 20 mins	10	333
	↘	24 & start exercise check in 20 mins	8	267
	→	18 & start exercise check in 20 mins	6	200
	↗ ↑ ↑↑	12 & start exercise check in 20 mins	4	133
7.0-10.0 mmol/L	↘ ↓ ↓↓	18 & start exercise check in 20 mins	6	200
	→	0 & start exercise check in 20 mins		
	↗ ↑ ↑↑	0 & start exercise check in 20 mins		
10.1-13.9 mmol/L	All Arrows	0 & start exercise check in 20 mins		
≥14.0mmol/L (Check BG) & ketones <0.6mmol/L	→ ↘ ↓ ↓↓	OK to exercise: No carbohydrate for 20 minutes		
	↗ ↑ ↑↑	OK to exercise: Consider 50% of correction dose before starting		
≥14.0mmol/L & ketones ≥0.6mmol/L	All Arrows	No exercise: Correction dose & ketones <0.6mmol/L before starting exercise