



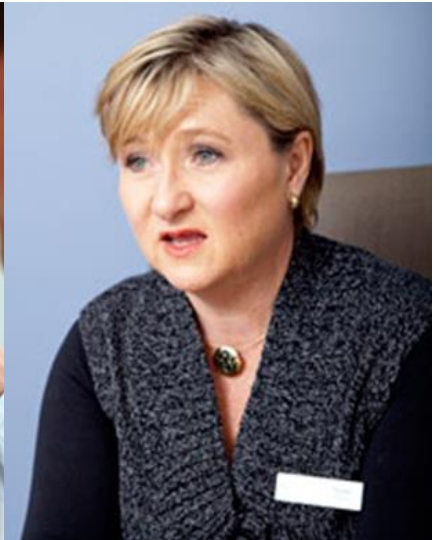
Type 1 Diabetes & Continuous Glucose Monitoring

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Let's consider the traditional diabetes clinic...



The Diabetes Clinic

I'm sure my HbA1c is going to be bad. He's going to really blast me today. I'm so scared of what he's going to say...

Whenever I check my sugar, it's high – even if I increase my insulin. It's so frustrating, I stopped writing them down.

He makes me feel so bad – it's already hard enough. That hypo last week really wiped me

He doesn't understand. I'm not going to come back



Patient with Type 1 DM

Your HbA1c is 8.9%. Your diabetes is poorly controlled. You need to check your sugars more and eat better.

The way you are going, you'll be in the dialysis unit before the end of the year.

She's such a hopeless diabetic. I don't know why I bother. No BGLs = No idea!



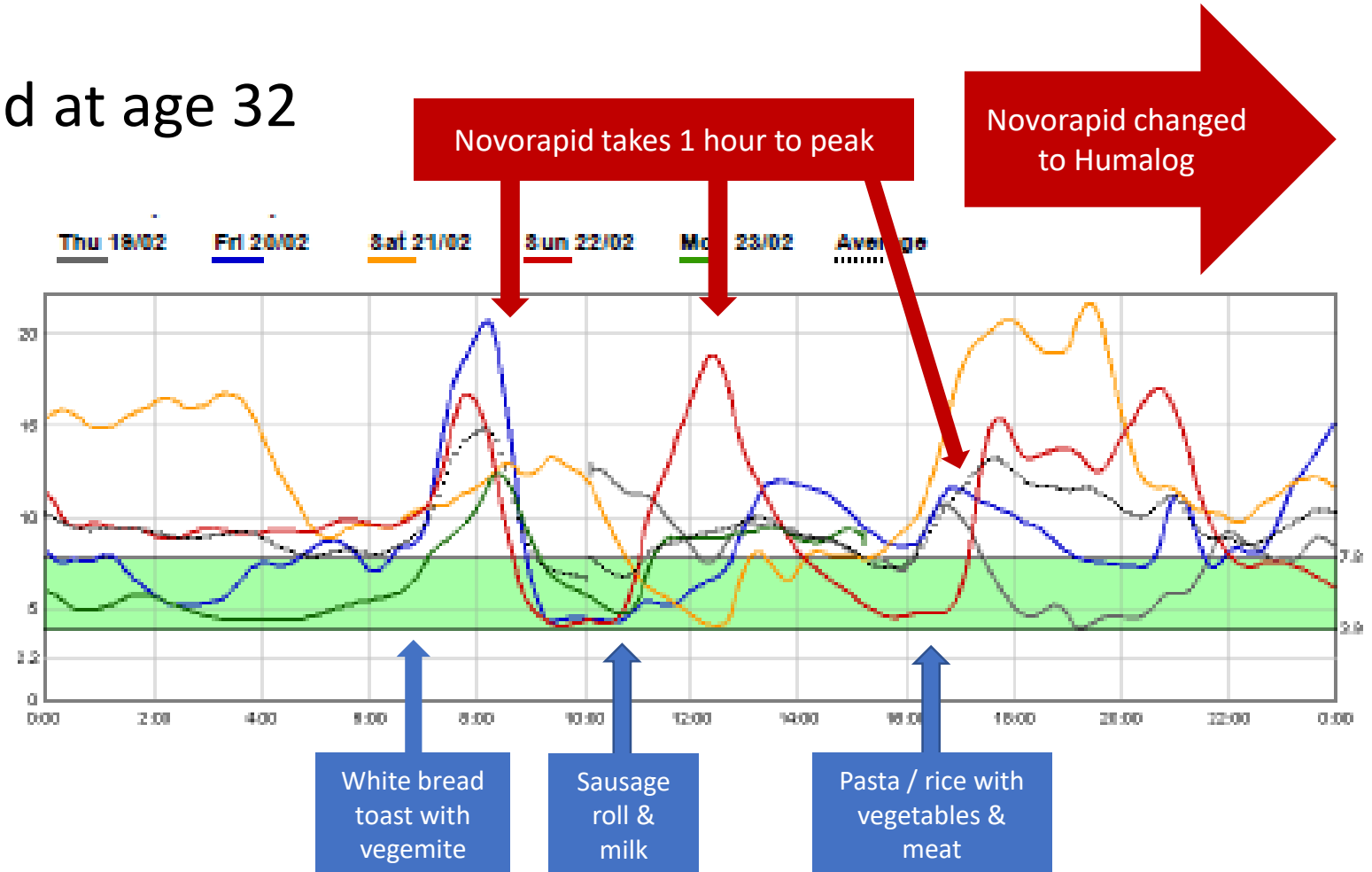
Tired Diabetes Doctor

How do we better understand each other & improve care?

?CGMS

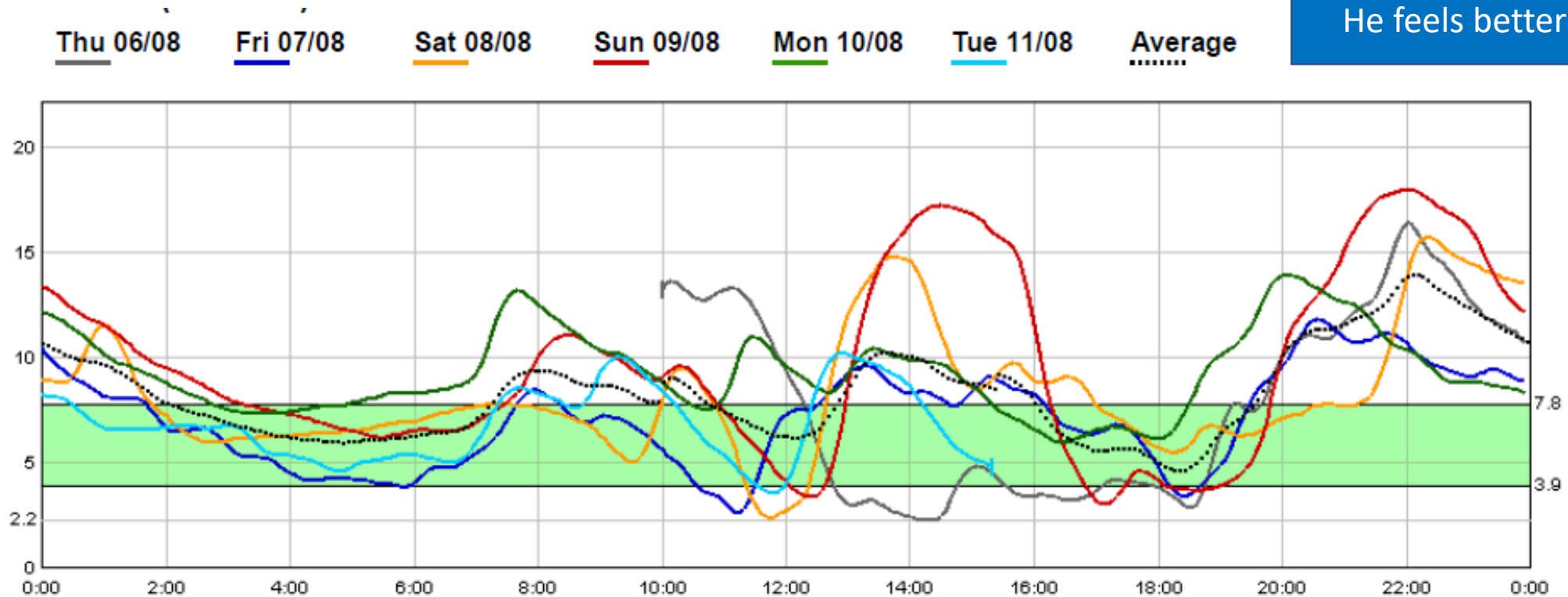
Meet Liam

- 37 year old man
- Type 1 Diabetes diagnosed at age 32
 - HbA1c 6.9%
 - No complications
- Glucose record:
 - 5 – 8 mmol/L pre-meals
 - No hypoglycaemia
- Feels exhausted...



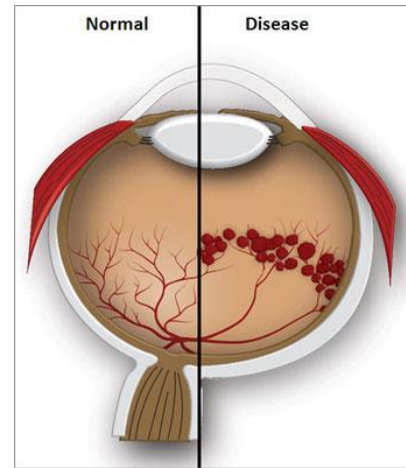
Change to Humalog (*but patient reveals poorer diet*)

HbA1c is still 6.9%
He feels better...

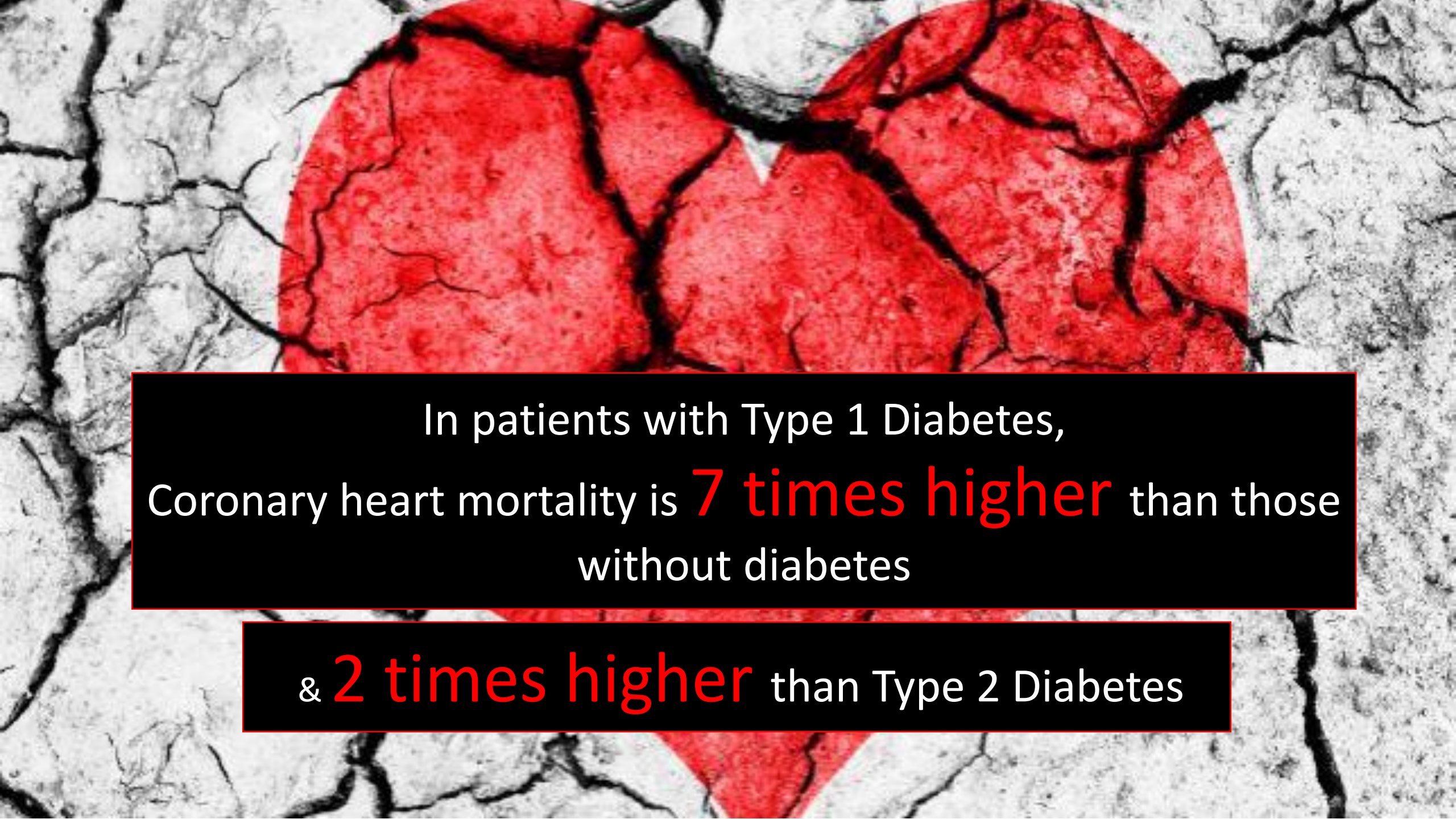


Glucose variability increases the risk for diabetic complications...*independent of HbA1c*

- Retinopathy ^{1,2,3}
- Peripheral neuropathy^{1,4}
- Nephropathy ^{1,2,3}
- Autonomic neuropathy⁵
- Severe hypoglycaemia ^{1,2,3}
- Cardiovascular disease ^{1,2}
 - Angina, MI, coronary revascularization

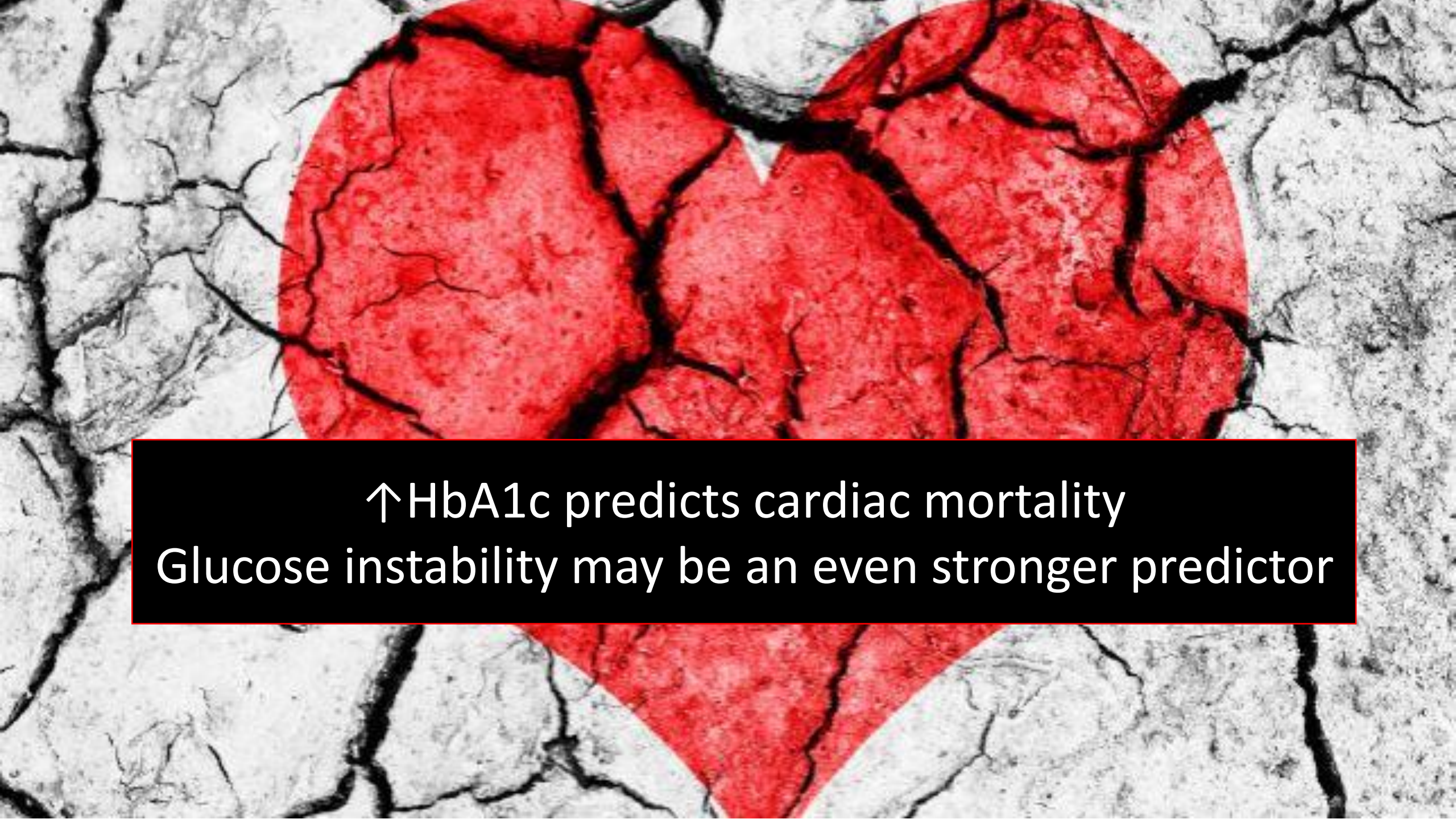


1. Kilpatrick et al. Diabetes Care 2006; 29: 1486-90
2. Kirkpatrick et al. Diabetes Care 2009; 32:1901-3
3. Lachin et al. 2008; 57: 995-1001
4. Sigelaar et al. Diabetologia 2009; 52: 2229-32
5. Houssay et al. 2011 ADA Conference Abstract



In patients with Type 1 Diabetes,
Coronary heart mortality is **7 times higher** than those
without diabetes

& **2 times higher** than Type 2 Diabetes



↑HbA1c predicts cardiac mortality
Glucose instability may be an even stronger predictor

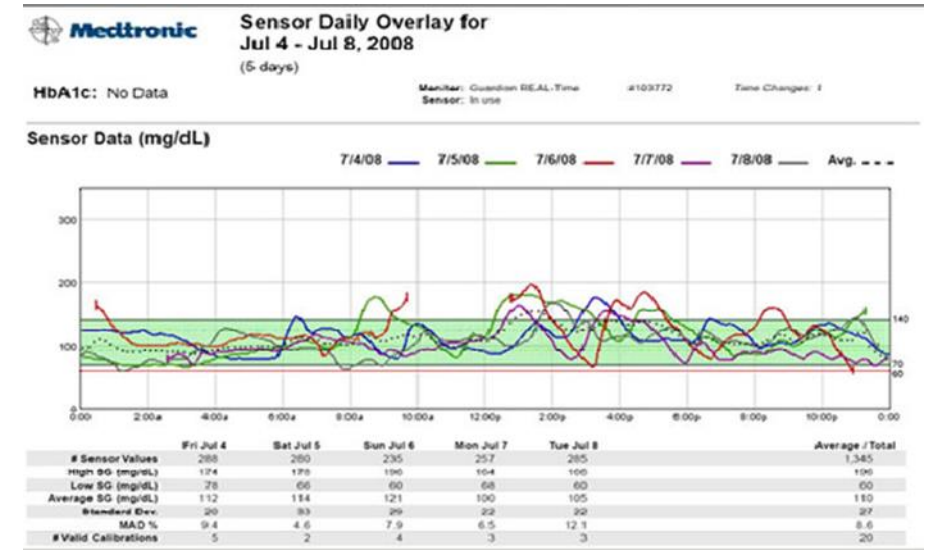
How can we help our patients stabilize their glucose levels?



How can CGMS improve glucose variability?

1. Retrospective CGMS

- Improve insulin prescribing
- Improve carbohydrate counting
 - patient education, change ratios
- Improve responses to exercise, alcohol, stress
- Better communicate changes to patients



2. Real time CGMS

- Improve patient engagement in self management
- Hypoglycaemia avoidance
- Proactive approach to exercise

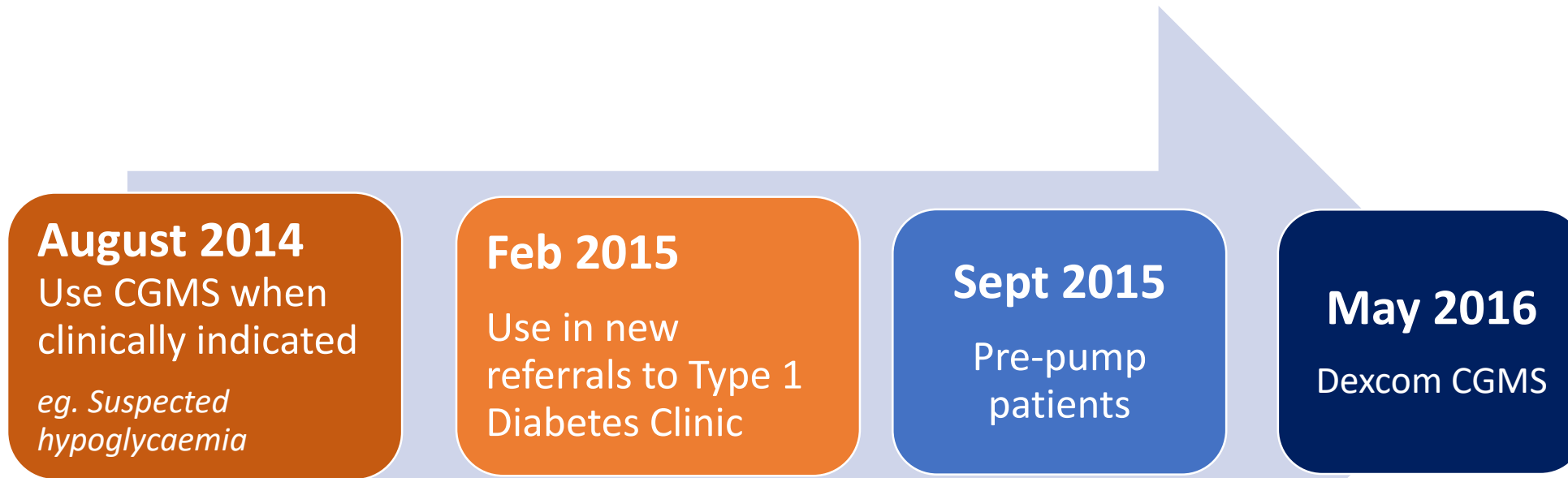


Use of real-time CGMS to improve glucose control

- Improved patient wellbeing
- Improved confidence in self-management
- Improved HbA1c
- Significant reduction in hypoglycaemic events
- Increased time in target glucose range
- Increased participation in exercise

RT-CGMS used intermittently for
3 – 6 months, with reflective
education sessions with DNE

Use of CGMS at Toowoomba Hospital Diabetes Clinic

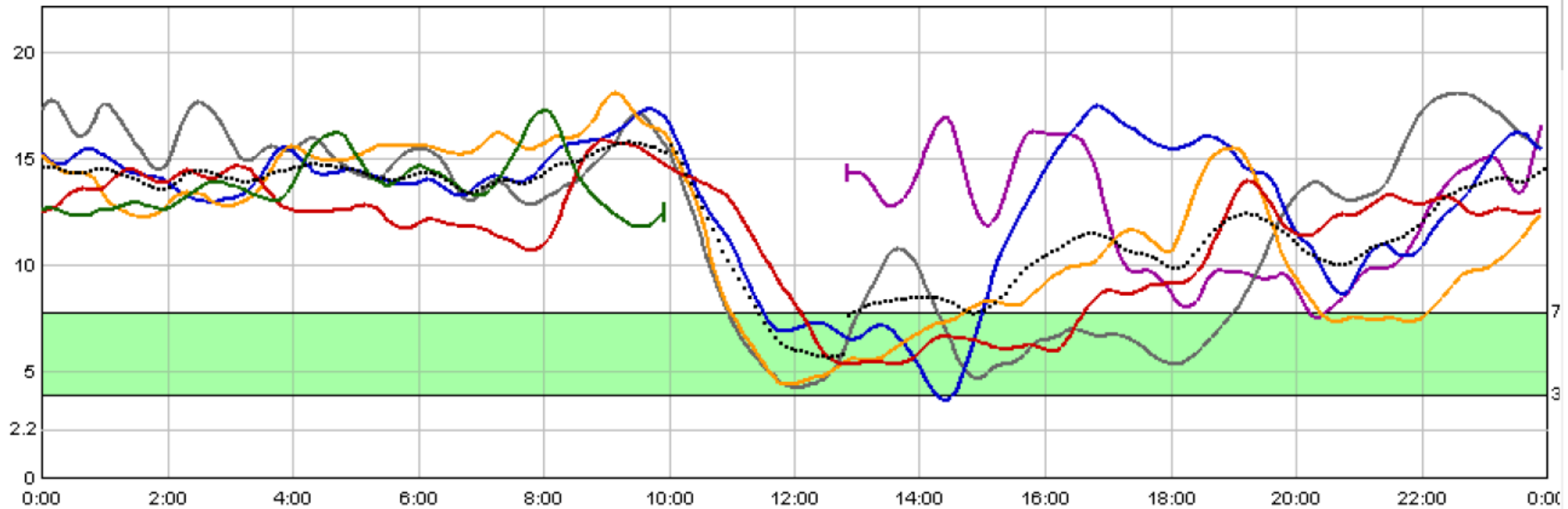


- >500 patient assessments
- 4 CGMS per week
- Waiting list 2-4 weeks

Type 1 Diabetes, Levemir 20 units mane, Humalog 6 units tds

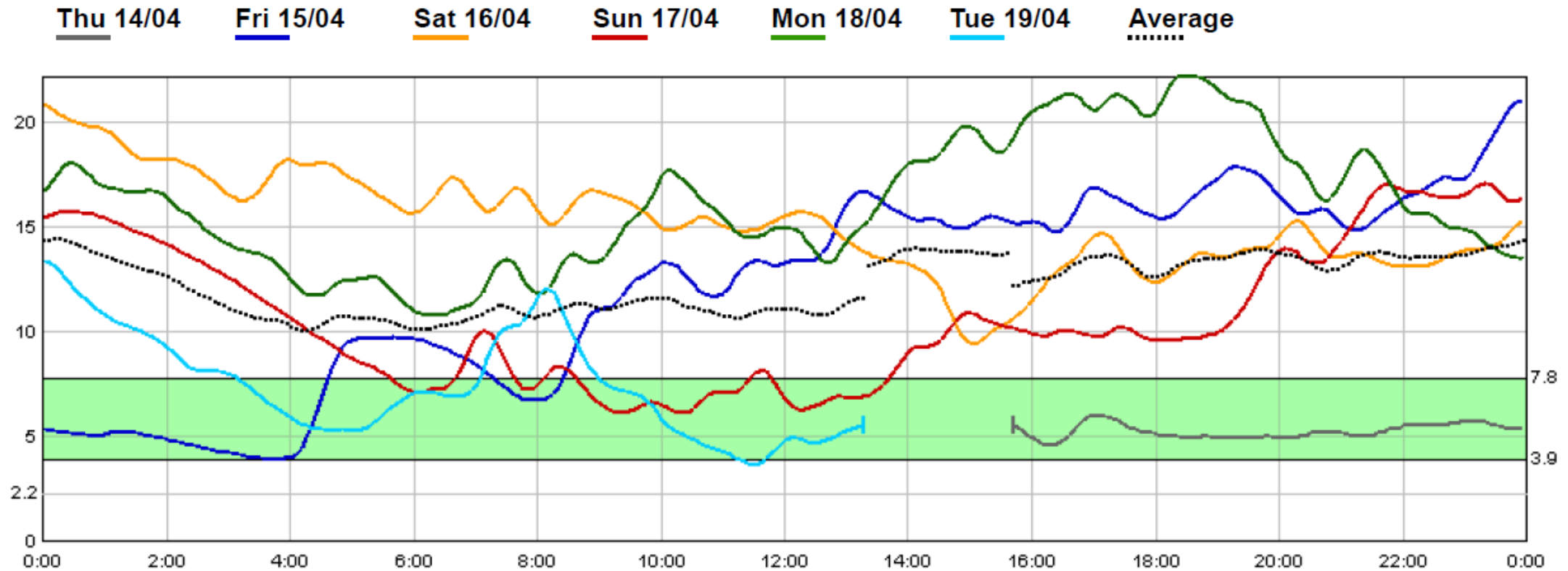
Sensor Data (mmol/L)

Wed 11/12 Thu 12/12 Fri 13/12 Sat 14/12 Sun 15/12 Mon 16/12 Average



Type 1 Diabetes, Lantus 14 units nocte, Novorapid 5 units tds

Sensor Data (mmol/L)



Type 1 Diabetes, Levemir 10units mane, 8 units dinner Humalog 4 – 6 units tds

Sensor Data (mmol/L)

Thu 03/12

Fri 04/12

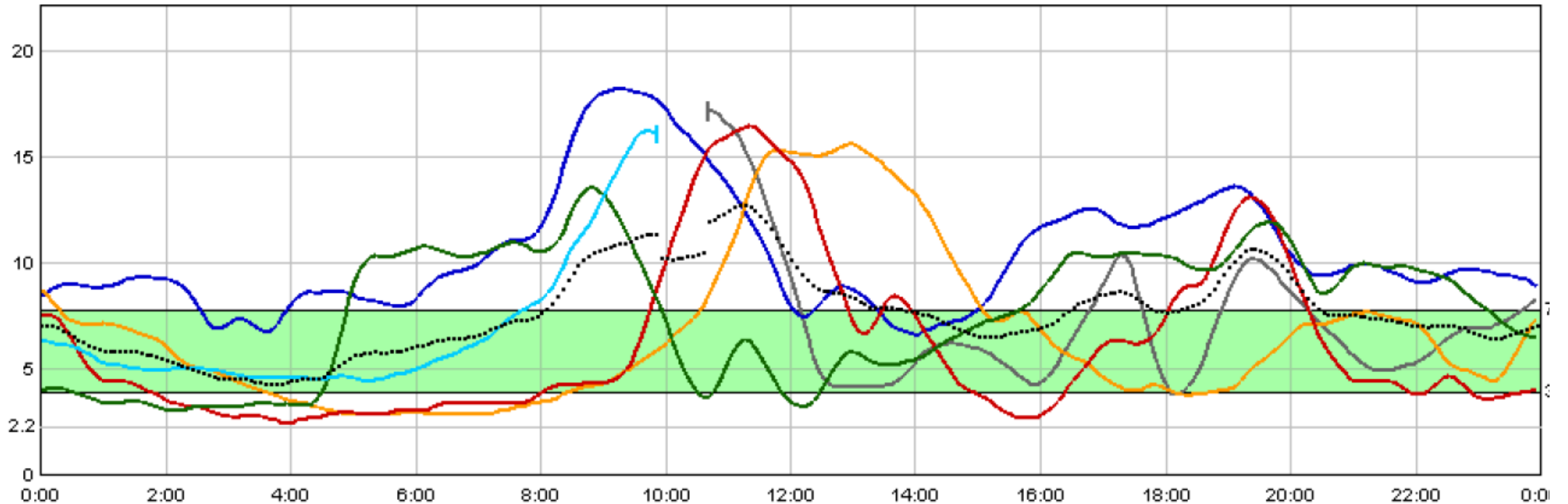
Sat 05/12

Sun 06/12

Mon 07/12

Tue 08/12

Average
.....



Meet Mary...

- 38 year old woman attending T1DM clinic
- Type 1 Diabetes diagnosed at age 12
“A brittle diabetic”
- Insulin pump at 34 yo, HbA1c 6.9%
- Complications:
 - Painful peripheral neuropathy
 - Background diabetic retinopathy
 - Proteinuria treated with ACE inhibitor



Continuous glucose monitor result, HbA1c 6.9%



17/07 - 22/07/2014
(6 days)

Medtronic iPro2 Recorder

#3085875

Sensor Data (mmol/L)

Thu 17/07

Fri 18/07

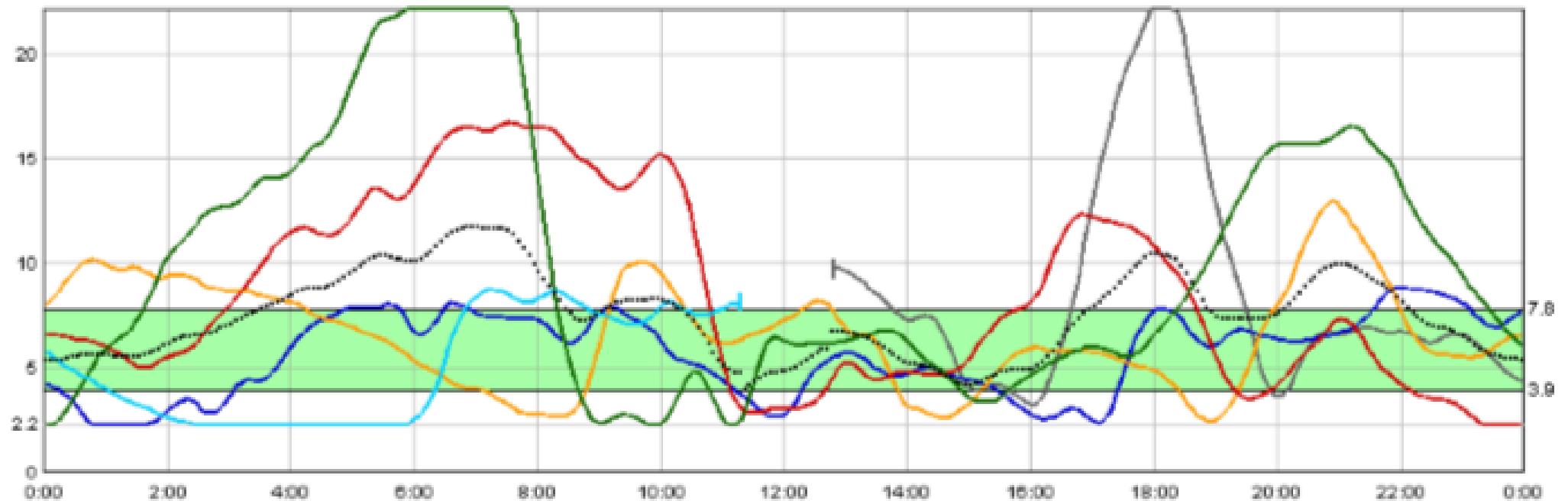
Sat 19/07

Sun 20/07

Mon 21/07

Tue 22/07

Average



25/06 - 30/06/2015

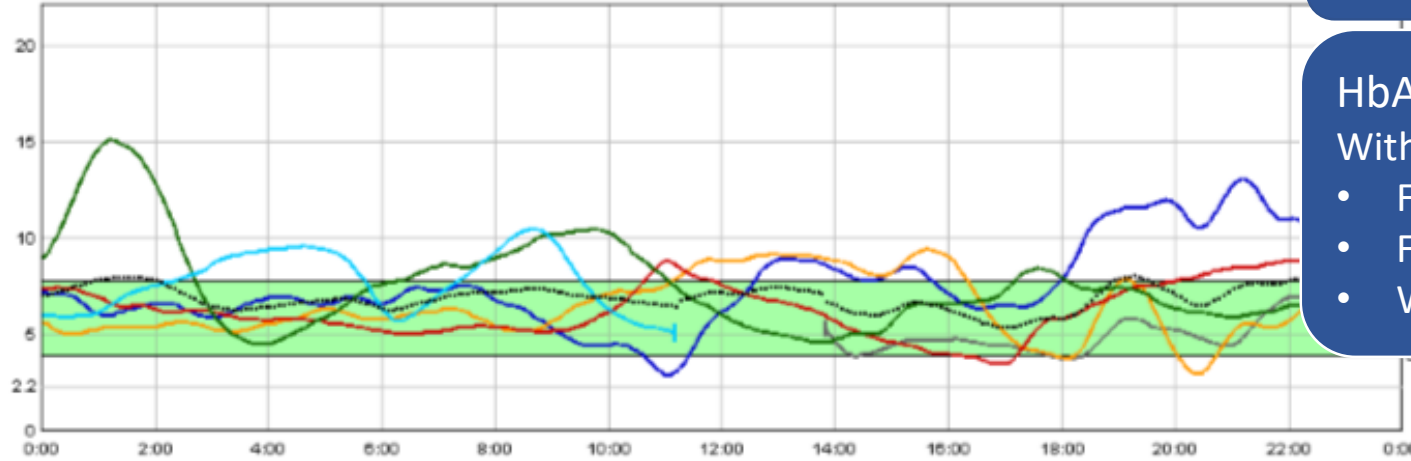
(6 days)

Medtronic iPro2 Recorder

#3066743

Sensor Data (mmol/L)

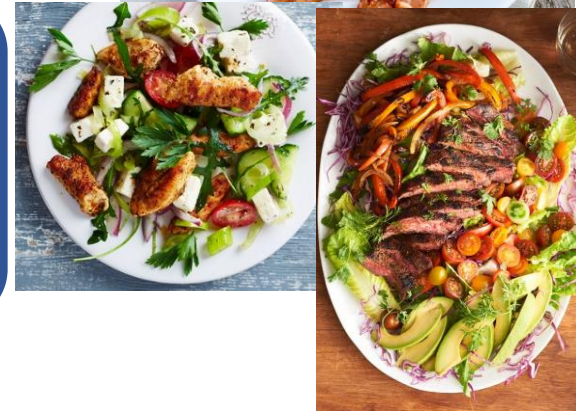
Thu 25/06 Fri 26/06 Sat 27/06 Sun 28/06 Mon 29/06 Tue 30/06 Average



Low carbohydrate diet
High protein

HbA1c 6.2%
Within 6 weeks:

- Foot pain resolved
- Frozen shoulder resolved
- Weight gain 4kg



18/08 - 23/08/2016

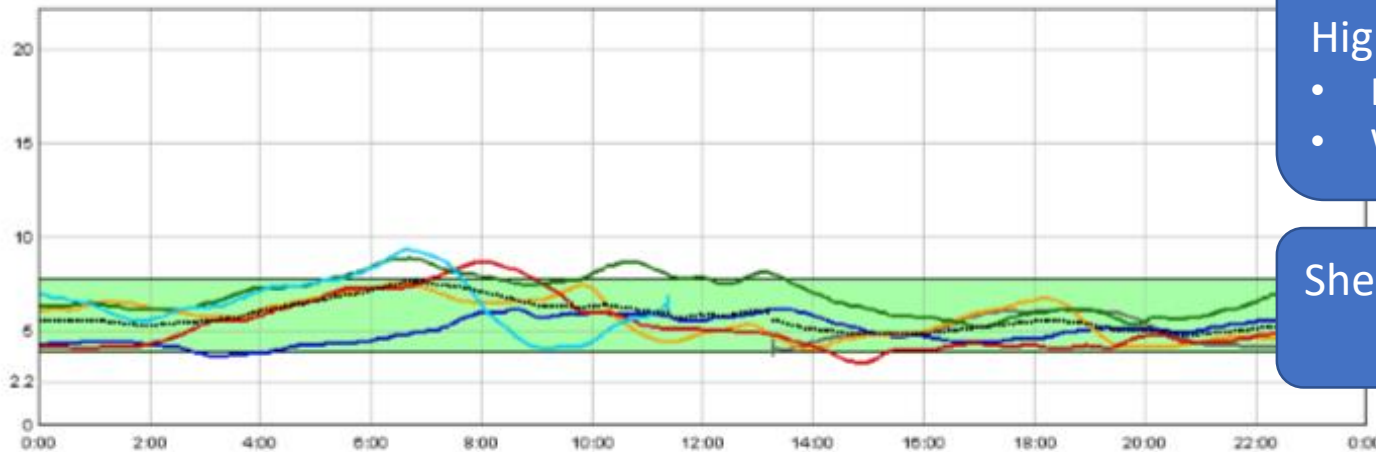
(6 days)

Medtronic iPro2 Recorder

#3077481

Sensor Data (mmol/L)

Thu 18/08 Fri 19/08 Sat 20/08 Sun 21/08 Mon 22/08 Tue 23/08 Average



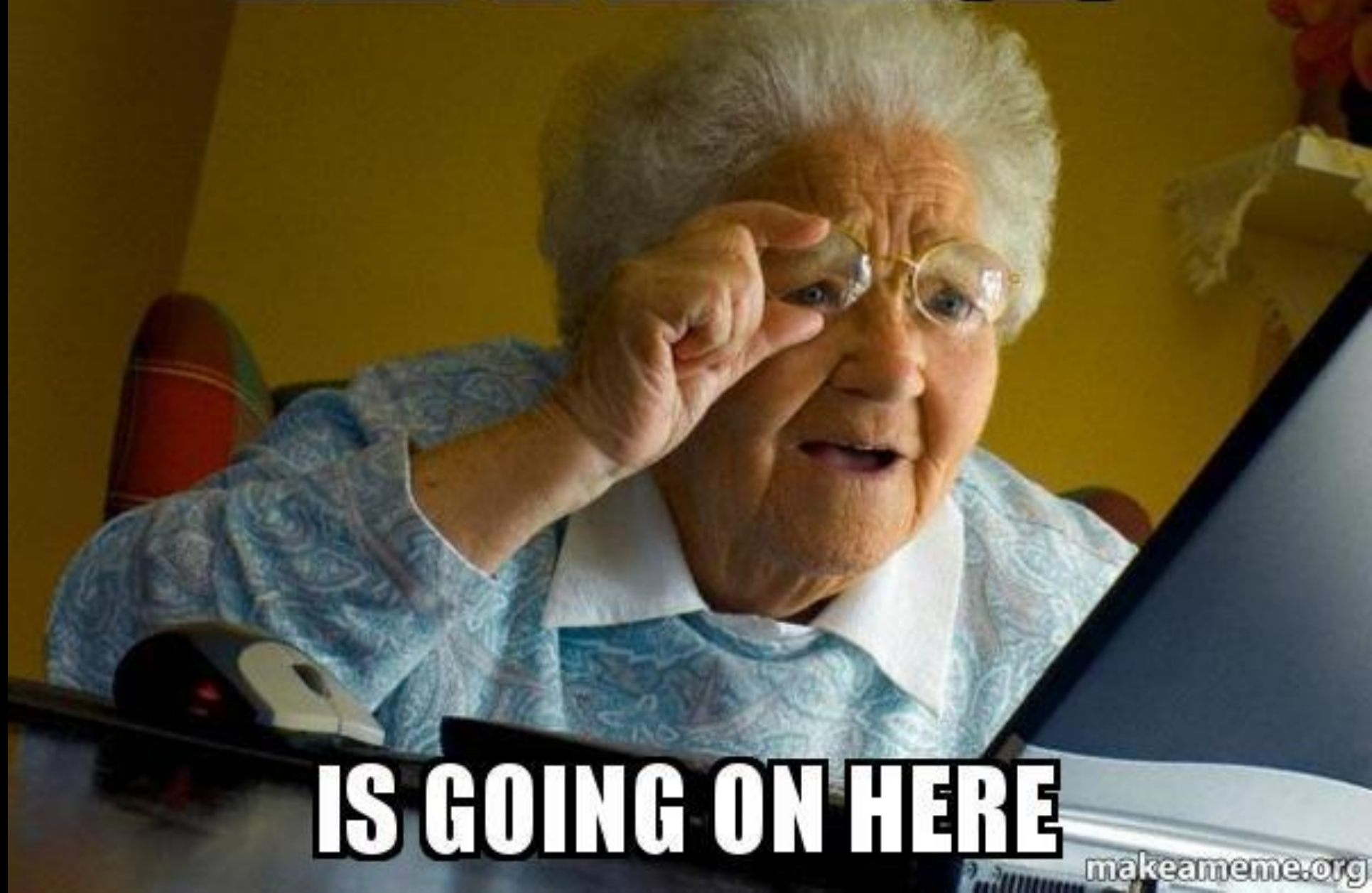
Low carbohydrate diet
High fat

- HbA1c 5.9%
- Weight loss 4kg

She's no longer a "brittle diabetic"

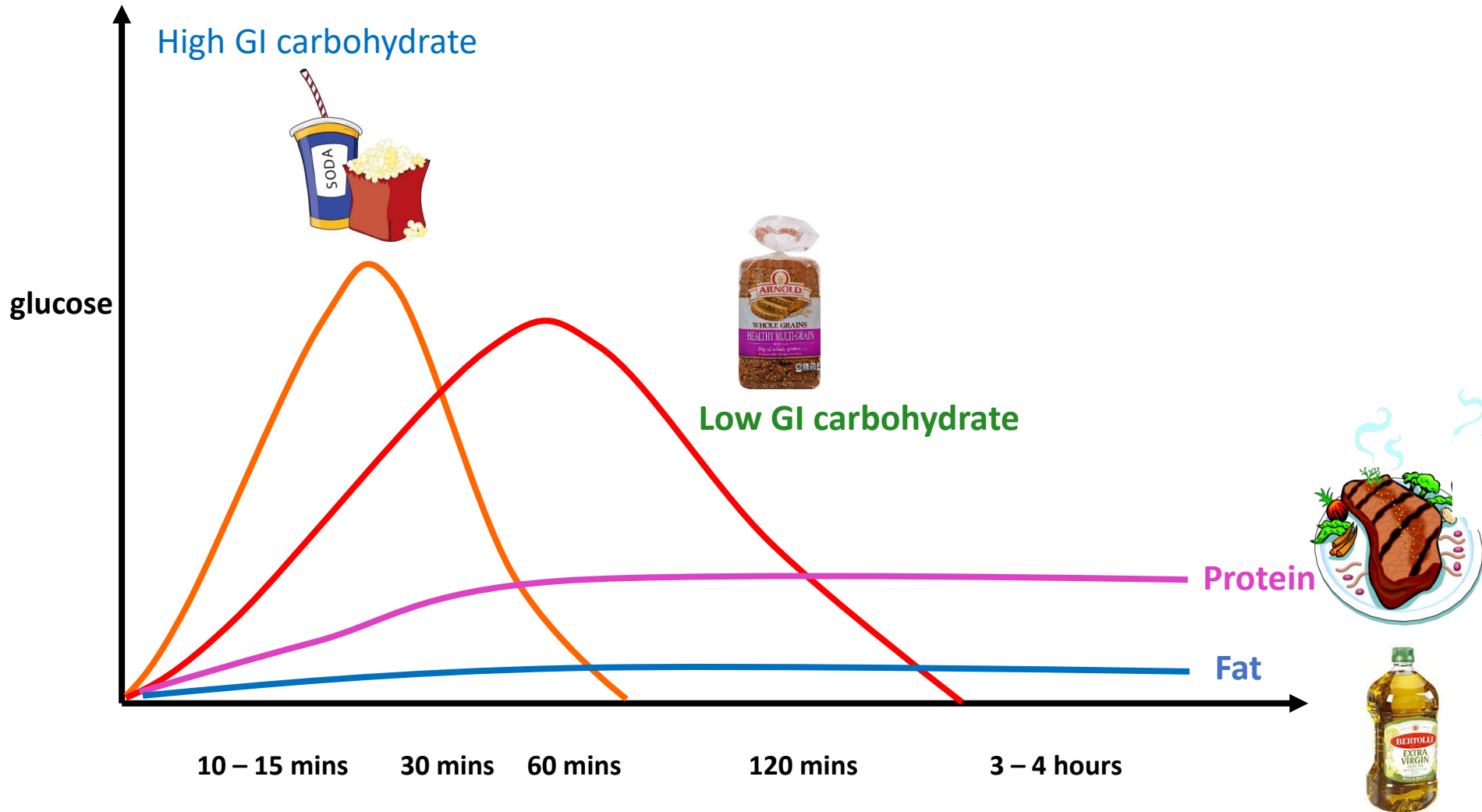


WHAT IN TARNATIONS



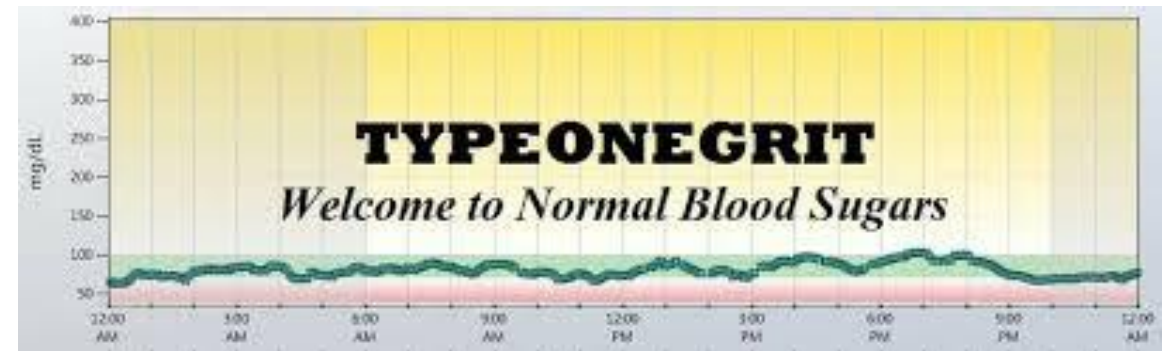
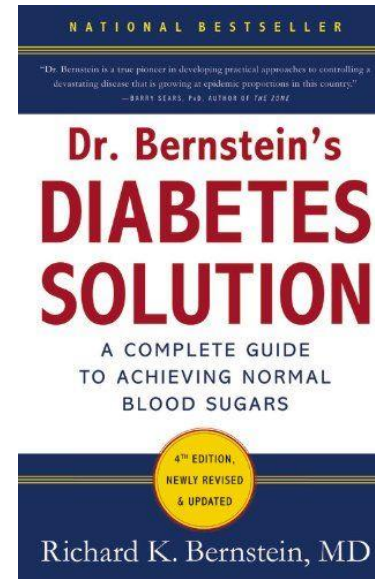
IS GOING ON HERE

Postprandial glycaemic response

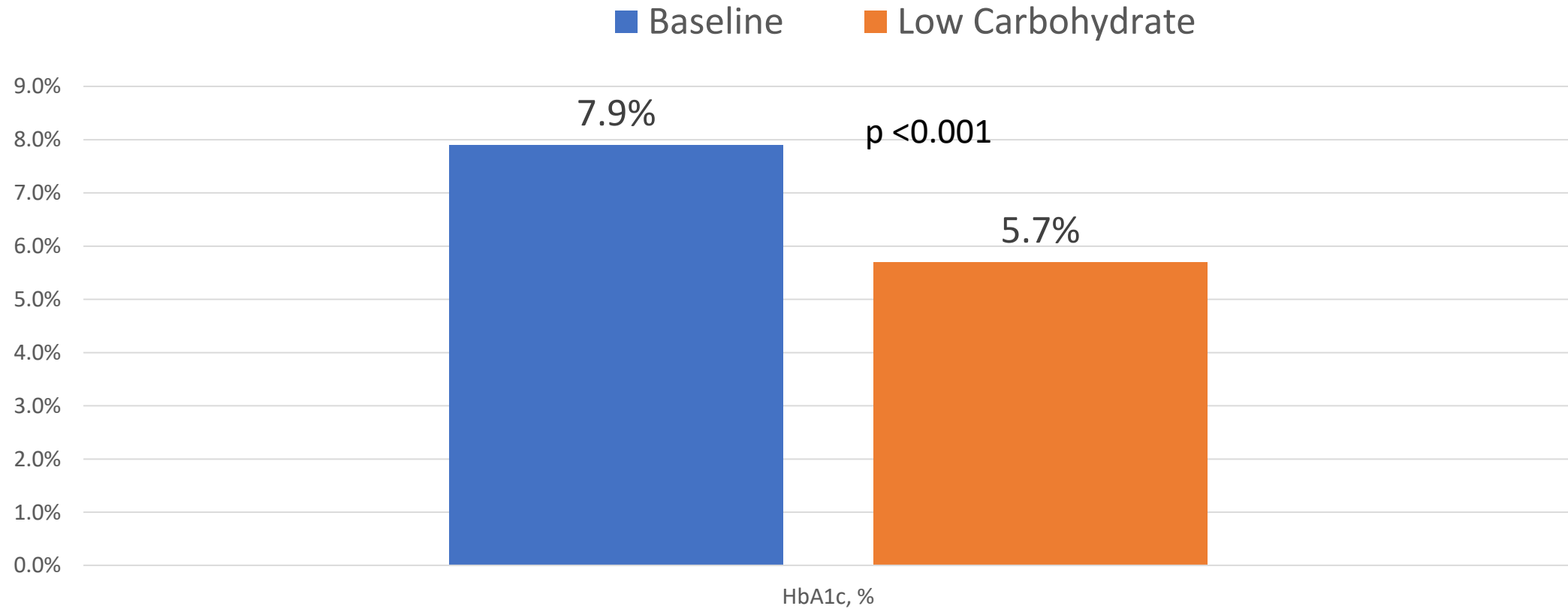


Mixed methods study of Australian adults who have adopted a very low carbohydrate diet

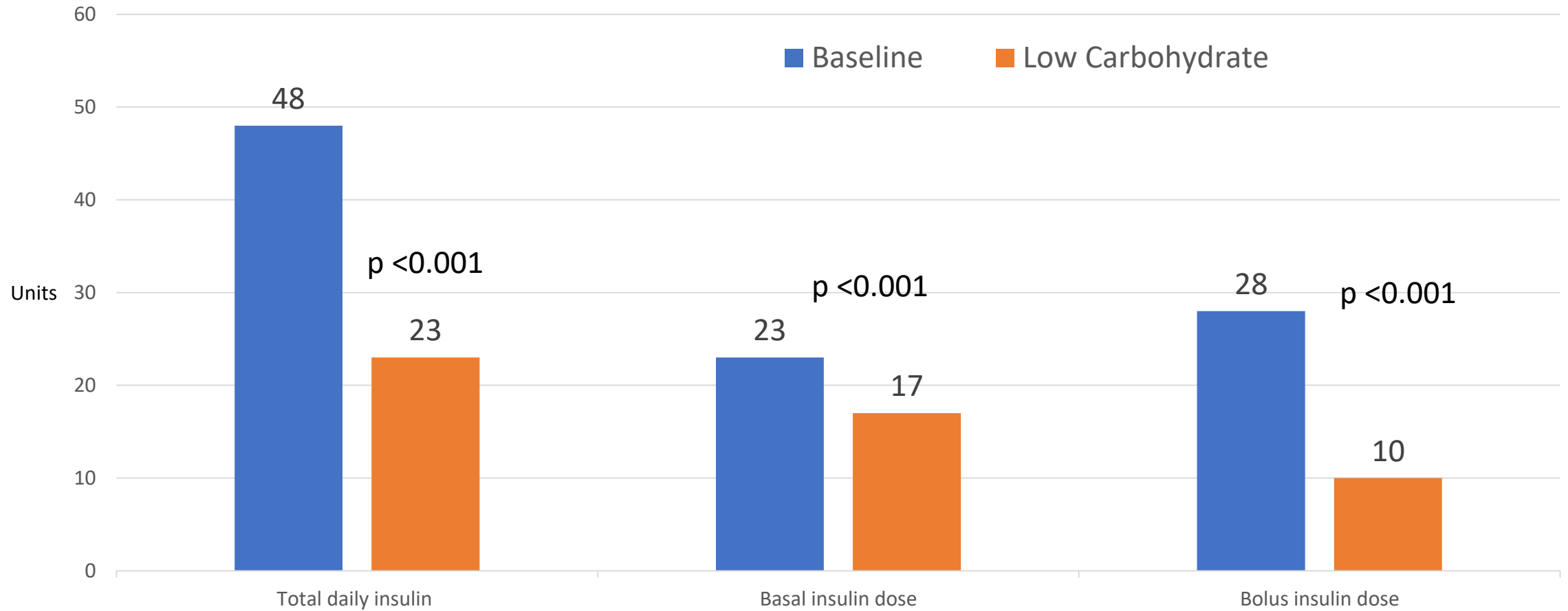
- Recruited from an Australian Facebook group that promotes low carbohydrate diet in T1DM
- n = 36
- Mean age = 45 years
- Mean duration of DM = 18 years
- 100% following Dr Bernstein diet
 - Mean daily carbohydrate intake = 36g
 - Duration of LCD = 3.5 years (Range 0.25 – 35)
- 9 had started low CHO at diagnosis
- 27 had changed from higher CHO to low CHO



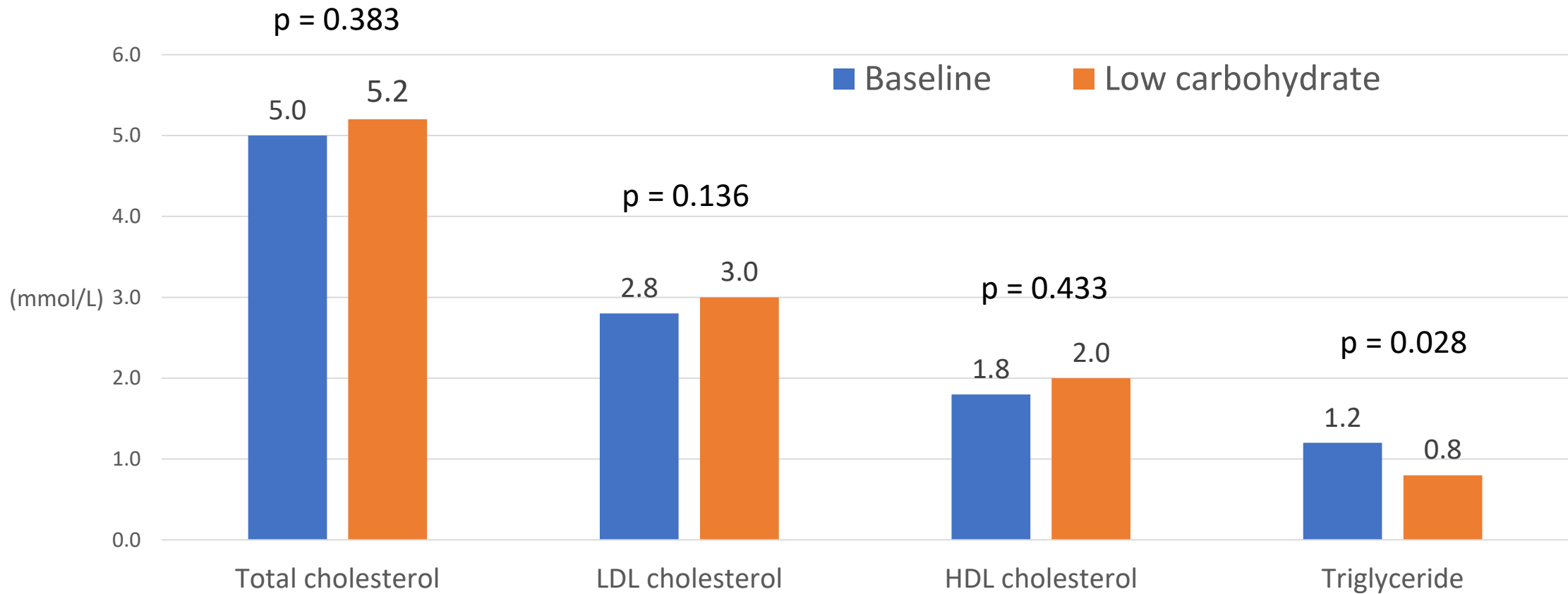
Results: HbA1c, n = 27



Results: Insulin requirement, n = 27



Results: Lipid profile, n = 12



Results of Questionnaire

Experience of Lowering
Carbohydrate in Type 1 DM
n = 36

Domain	Questions	Agree or strongly agree
Glucose control	My glucose levels have been easier to control	100%
	My glucose levels have been lower overall	100%
	It is easy to work out my insulin doses	94%
	I have had more hypo's	6%
	I have found it hard to manage the hypo's	0%
Confidence in managing diabetes	I feel more confident in managing my diabetes	100%
	I feel more in control of my diabetes	100%
Health effects	My energy levels are better	91%
	This has been good for managing my weight	86%
Enjoyment of food	I enjoy eating this more than my previous diet	83%
	I feel free to eat what I want to eat	54%
	I am always worried about what I can eat	11%
	I have trouble choosing foods in restaurants	57%
Appetite control	My appetite is better satisfied	100%
	I often feel hungry	3%
Cost of food	Eating like this is more expensive	37%
	My food bills are no different on this diet	46%
Education about diet	I found a lot of information via social media	88%
	Social media helps to motivate me to eat this way	80%
	It is easy to find information about low carb diets	91%
	It is easy to find information about low carb diets and diabetes	57%

Qualitative analysis... key findings

- Internet and social media are key drivers of behaviour change

- Community of support
- Information – journal articles, YouTube videos

- Rapidly adopt low carbohydrate diet after reading Dr Bernstein's book

"So, I ordered the book, Dr Bernstein's Diabetes Solution, and actually, that was the last time I ate carbs. I have not eaten carbs at all since that day. My life has completely changed."

- Rapid, dramatic improvement in diabetes control, quality of life

"Well definitely the low hunger, the no hypoglycaemic attacks, much flatter lines for my blood glucose, lower HbA1c, lower risk of complications and my athletic performance is improved."

"So I did it for a week straight, and I remember my blood sugar didn't go above 9, and it was so stable and I just remember thinking, "This is incredible. I didn't realize it could be this good. I don't have to deal with going high every day from these high carb meals and my insulin not working."

- Negative perception of endocrinologists, dietitians

"I went twice to an adult endocrinologist and had a very negative experience. He went into, "That's not normal to be on so little insulin. If you're not eating carbohydrate, what are you eating?" Why would I ever put myself in that situation again?"

"And the endocrinologist: she's not at all supportive. I just get lectured. I walk out feeling like the naughty child all the time."

Summary

- CGMS can be used in clinic to improve:
 - Patients' experience of your service
 - Insulin prescription
 - Glucose control – reduced variability, HbA1c
 - Patients' self-management & confidence
- CGMS has completely changed my practice...





Questions?