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9-10, October, 2026



Longevity and Biological Ageing: Enhancing Health into Advanced Age



9-10, October, 2026

SESSION 3

Natalie Burrows,
Registered Nutrition Practitioner

Measuring What Ages You: CGM, Glucose Variability,
and the Case for Earlier Intervention

12:00-12:45pm

An event by:  Nutritional Medicine Institute

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INTEGRAL
WELLNESS

Measuring What
Ages You:
CGM, Glucose Variability,
and the Case for Earlier
Intervention

9-10, October, 2026

Presented by

Natalie Louise Burrows

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Hi I'm Natalie

- BANT Registered Nutrition Practitioner & Functional Medicine Certified Health Coach with over 5 years of clinical experience.
- Clinic Director of Integral Wellness, a Cardio-Metabolic Health Clinic and a team of three BANT NTs.
- Currently studying MSc in Nutrition & Lifestyle Medicine at the University of Worcester
- Client case support and business mentor to practitioners
- CGM and blood sugar geek for the prevention and reversal of type 2 diabetes
- Radio and press interviews and podcast guest
- Guest lecturer, event speaker, nutrition consultant

Nutritional Therapist,
Health Coach, Clinic Director,
Nutrition Consultant

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Other areas of work:

- I lecture for Lingo on a freelance basis.
- I am Head of Nutrition for Tonic Health on a freelance basis.

Clinically agnostic:

- My consultancy work does not influence my clinical recommendations. I remain clinically agnostic, with recommendations guided by the available evidence and individual clinical context.

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Learning outcomes

Agenda

45-minute presentation.

Why glucose variability is a marker of biological ageing, visible years before HbA1c or fasting glucose raises concern.

How hidden glucose dysregulation drives appetite dysregulation, low energy, mood/focus issues, cognitive decline and vascular ageing.

How to apply CGM data in non-diabetic and pre-diabetic clients/patients to support personalised, preventative interventions.

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Why frame glucose variability as “ageing”

Glycaemic variability (not just average glucose) is independently associated with two recognised drivers of biological ageing:

- oxidative stress
- the accumulation of advanced glycation end-products (AGEs)

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Short- and intermediate-term glucose variability independently predicts oxidative stress markers and AGE accumulation, separate from average glucose control.

AGEs cross-link proteins in vessels, skin and joints and trigger the same inflammatory (RAGE) pathway implicated across age-related disease - an inevitable component of the ageing process.

This accumulation occurs independently of a diabetes diagnosis: elevated AGE levels predict mortality risk in older adults regardless of diabetes status.

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The UK landscape

Over 55%

of UK adults now show biomarkers of insulin resistance - more than 1 in 2 people.

15 million

Britons are predicted to have pre-diabetes. Most are completely unaware.

36%

of children aged 10-11 are overweight or obese.

£15 billion

projected NHS cost of treating type 2 diabetes alone in 2025.

168,000

under-40s living with type 2 diabetes - up 40% since 2016/17.

64%

of UK adults overweight or obese, up from 1993 (obesity alone: 28%).

1600+

under-19s now diagnosed with type 2 diabetes.

17 million

adults (1 in 3) at increased risk of type 2 diabetes by 2030.

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Glucose isn't just a 'diabetes issue'

Even in people without diabetes, CGM reveals regular, sometimes significant, glucose fluctuations:

- after meals
- during periods of stress
- sleep disruption

Non-diabetic populations can experience postprandial glucose excursions above 7.8 mmol/L (140 mg/dL), especially after high-glycemic-index meals.

Journal of Diabetes Science and Technology

Impact Factor: 3.7

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Use of Continuous Glucose Monitors by People Without Diabetes: An Idea Whose Time Has Come?

David C. Klonoff, MD, FACP, FRCP (Edin), Fellow AIMBE, Kevin T. Nguyen, BA, L-L, and Alaina P. Vidmar, MD

View all authors and affiliations

Volume 17, Issue 6 | <https://doi.org/10.1177/19322968221110830>

Increased time above range (TAR), even in non-diabetic groups, is linked to a higher risk of future diabetes and metabolic disease.

CGM-based studies have shown that monitoring glucose in health, wellness, and athletic cohorts enables early identification of unhealthy patterns well before disease manifests.

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Pre-diabetes matters – even without progressing

- Study: n=10,310 adults, 30-year follow-up.
 - 60% had pre-diabetes at baseline; only ~30% went on to develop diabetes (median 7 years).
- Finding: Progression to diabetes explained less than 25% of the long-term clinical risks associated with pre-diabetes.
- Clinical takeaway: pre-diabetes/insulin resistance is a legitimate intervention point.
- Note: The relative risk was greater in cohorts including women than in cohorts of men.



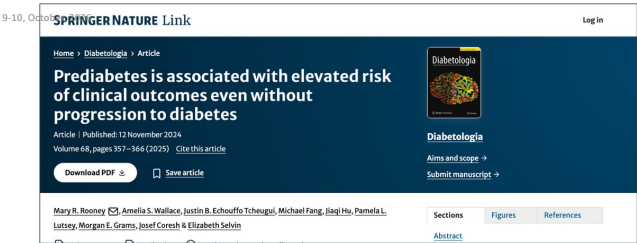
85%
of the excess risk for any complication remained even without progressing to diabetes. Only ~15% was explained by progression itself.



78%
of excess all-cause mortality risk remained.



77% vs 68%
Developed a complication (ASCVD, heart failure, CKD, or death) over the 30 years; pre-diabetes vs normoglycaemia at baseline.



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Normoglycaemia › Pre-diabetes › Type 2 diabetes

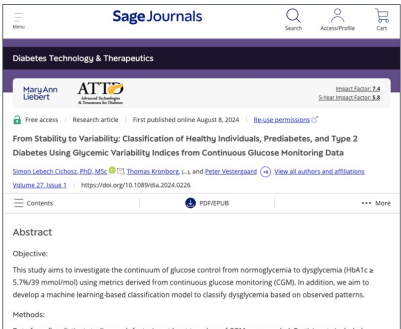
Aim: investigate the continuum of glucose control from normoglycemia to dysglycemia (HbA1c ≥ 5.7%/39 mmol/mol) using metrics derived from CGM data.

- Pooled analysis, cohort n=836:
- Normoglycaemia (n = 282)
 - Pre-diabetes (n = 133)
 - Type 2 diabetes (n = 421 (A1c = <6.5% / <7% / ≥7%))

- | | |
|-----------------------------------|-------------------------------|
| Mean glucose rise: | Time in range (70-140 mg/dL): |
| • Normoglycaemia = 99 mg/dL | • Normoglycaemia = 95.3% |
| • Pre-diabetes = 105 mg/dL | • Pre-diabetes = 93.6% |
| • Type 2 diabetes = 123-181 mg/dL | • Type 2 diabetes = 20-79% |

Conclusion: The study reveals a progressive deterioration of glucose homeostasis and an escalation in glycemic variability from healthy individuals to those with pre-diabetes and diabetes.

“While overall variability tends to increase with disease advancement, there is a notable decrease in the mobility of the signal, particularly evident in the transition from healthy to prediabetic states.”



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Norm- vs Pre- vs. Diabetes: Glucose patterns

The Framingham Heart Study (n=1175):

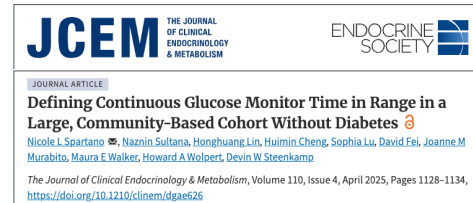
- Normoglycemia (n = 560)
- Pre-diabetes (n = 463)
- Diabetes (n = 152)

Aim: To report the physiological range of CGM time-in-range (TIR) values observed across glycemic status.

Results: CGM shows a graded decline in TIR across categories.

Conclusion: Increased understanding of the physiological CGM range in people without diabetes. Clinicians can use this as CGM sensors become more widely accessible.

"Clinicians should expect that many patients without elevated HbA1c or fasting glucose could have CGM reports showing glucose values greater than 180 mg/dL." (10 mmol/L)



Time-in-range: 3.9-10.0 mmol/L (70-180mg/dL)



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What is a CGM?

Continuous glucose monitor

The technology

A small biosensor worn on the upper arm measures glucose continuously in interstitial fluid (not blood) via an electrochemical reaction, transmitting readings every minute to a paired app.

What it measures

Real-time glucose values, directional trend arrows, time-in-range, time above / below range, glycaemic variability, and average glucose over the wear period (up to 14 days per sensor).

A note on accuracy

Interstitial glucose lags blood glucose by ~5-15 minutes, especially during rapid change (e.g. exercise).

CGM is not equivalent to laboratory diagnostics and should not replace other forms of testing.



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Medical vs preventative use

MEDICAL USE

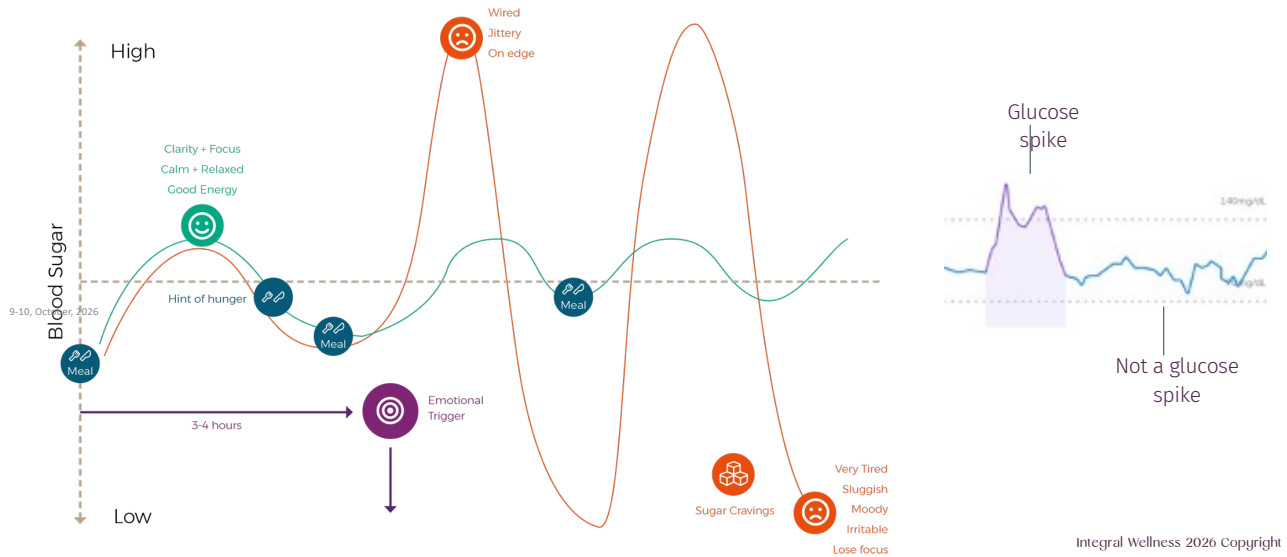
- People with T1D and insulin-dependent T2D
- Monitoring glycaemic control & detecting hypoglycaemia
- Guiding insulin dosing decisions
- Regulated device, prescribed by clinicians
- Strong, long-established evidence base
- Not suitable as a substitute: "wellness CGMs" (e.g. Lingo) are NOT for diabetes management

PREVENTATIVE USE

- Adults without diabetes seeking metabolic insight
- People with pre-diabetes, insulin resistance, obesity
- Surfaces hidden glucose patterns before clinical thresholds
- Connects diet, sleep, stress & movement to real glucose response
- Behaviour change tool - not diagnostic
- Emerging, rapidly growing evidence base

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Physiological impact of glucose flux



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Five ways glucose variability drives common symptoms & ageing-relevant signs

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Physiological impact of glucose flux



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Cravings &
appetite



Mood &
energy levels



Sleep



Cognition &
focus



Cardiovascular
ageing

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Cravings and appetite

What can we measure today:

Study outcomes showed the 2–3-hour post-meal dip (not the spike) is the best predictor of hunger and earlier next meal;

- +19% energy intake at 3-4hrs
- +27% calories over 24hrs (all $P < .001$, independent of age/BMI/weight)

Postprandial insulin response is linked to satiety in healthy individuals but is blunted in overweight/obese individuals.

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The longevity impact:

Living with obesity puts an individual at risk of severe comorbidities and reduced life expectancy.



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Mood, energy & mental health

What can we measure today:

Study outcomes demonstrated that a high-GI diet:

- +38% depressive symptoms
- +55% total mood disturbance
- +26% fatigue/inertia
- 40% larger effect in overweight/obese

"If you're insulin-resistant, your risk of developing major depressive disorder is double that of someone who's not insulin-resistant, even if you've never experienced depression before." - Professor Natalie Rasgon

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The longevity impact:

Recurrent or untreated depression can reduce life expectancy.



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Sleep

What can we measure today:

An RCT showed that increasing sleep by 1.2 hours was associated with an average of 270 fewer calories per day in "overweight" (BMI category) adults who averaged 6.5 hours of sleep.

The longevity impact:

Lower glucose levels and less variability are linked to more sleep hours. Greater sleep sufficiency can reduce calorie consumption. Over time, this could lead to clinically important weight loss.

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But sleep regularity may support longevity and reduce mortality risk more than sleep duration alone.



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Cognition and focus

What can we measure today:

A study concluded that a low-GI breakfast beats a high-GI breakfast on:

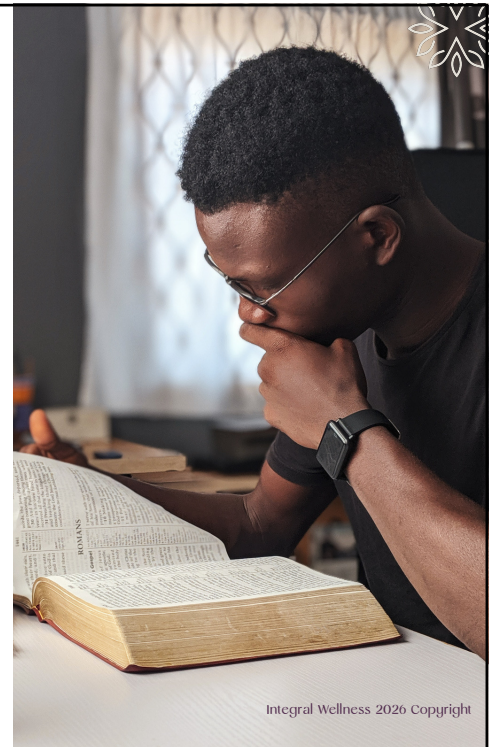
- Memory (90min)
- Attention (170min)
- Stable late postprandial glucose
- Overall outcome = improved cognitive performance

Brain insulin resistance is linked to obesity, cognitive decline, and Alzheimer's neuropathology. Memory and focus deficits often appear before markers of major metabolic or neurological disease.

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The longevity impact:

A dementia diagnosis can reduce life expectancy. In a study, overall, men with dementia did not live as long as women with dementia.



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Cardiovascular ageing

What can we measure today:

1-hour post-load plasma glucose ≥ 8.6 mmol/L is associated with a high risk of both macrovascular and microvascular complications.

Elevated glycaemic variability in pre-diabetes is linked to cardiovascular disease risk, independent of obesity or traditional risk factors.

The longevity impact:

Vascular ageing also occurs within the normoglycaemic and pre-diabetic window.

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CGMs in practice

Review: The use of continuous glucose monitoring in people living with obesity, intermediate hyperglycemia or type 2 diabetes.

Battellino's 2025 clinical research and consensus takeaways:

- CGMs often reveal hidden glucose spikes and higher glycemic variability in people with obesity - even when they don't have type 2 diabetes or abnormal HbA1c lab results.
- For people without diabetes, tracking the percentage of time spent above the "healthy range" (>7.8 mmol/L or 140 mg/dL) with CGM data is recommended.
- For people without diabetes, every 5% improvement in time-in-range can lead to meaningful reductions in long-term metabolic and vascular risk.

Battellino's thresholds and targets help practitioners interpret CGM data accurately, guide early dietary and lifestyle interventions, and guide people toward optimised wellbeing before glucose dysregulation develops.

Diabetes Research and Clinical Practice

The use of continuous glucose monitoring in people living with obesity, intermediate hyperglycemia or type 2 diabetes

Tadej Battellino^{1,*}, Nebojsa Lalic², Sufyan Hussain^{3,4,5}, Antonino Cersillo⁶, Sanja Khobacsi⁷, Sarah J. Davies⁸, Pinat Toporever⁹, Julie Hervey¹⁰, Francesca Ulivi¹¹, Kevin Brady¹², Tsvetelina Todorova¹³, Jilia Galardo¹⁴, Rostas Tzagalos¹⁵, Erik Wersson¹⁶, Chantal Mathieu¹⁷, Peter Schreier¹⁸

ABSTRACT

A global trend towards increased obesity, intermediate hyperglycemia (previously termed prediabetes) and type 2 diabetes, has prompted a range of international initiatives to successfully raise awareness and drive action across communities to prevent and manage these global health issues. One approach, that has shown success in managing people already diagnosed with type 2 diabetes mellitus, is to use continuous glucose monitoring (CGM) devices to help them manage their diabetes condition through understanding and knowing their daily glucose fluctuations, in combination with glucose-lowering medications, including insulin. However, much of the burden of type 2 diabetes mellitus is revealed in the different diabetes levels of type 2 diabetes mellitus itself, and the intermediate hyperglycemia that precedes it. In this review, we provide evidence that using CGM technology to provide insight of intermediate hyperglycemia in type 2 diabetes mellitus can significantly improve the risk of long-term complications of diabetes. Based on clinical data presented, we suggest that continued use of CGM to guide changes in diet and lifestyle, that can alone or in combination with glucose-lowering medications, will help further research to establish its role in reducing the long-term effects of this intervention in people at risk or with early dysglycemia, the preposition for use of CGM technology in clinical practice.

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CGMs in practice

Clinical approach with clients:

Goal: <5% above range (>7.8 mmol/L or 140 mg/dL)

- Focus on wellbeing, optimising energy, mood, sleep, hunger, etc.

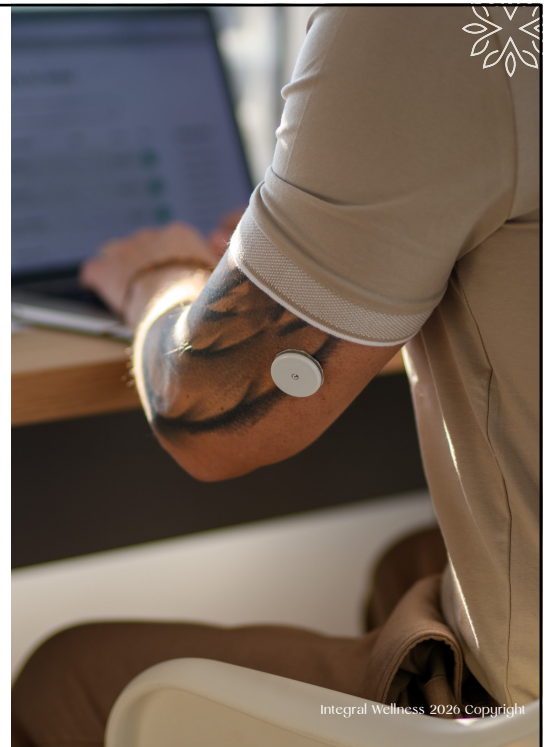
Start by reviewing time above range (>7.8 mmol/L or 140 mg/dL)

- Address: >5% above range
 - Consider investigating influences (diet, meal timing, sleep, lifestyle) and implement strategies to lower excursions.

Evaluate daily and weekly patterns:

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- Look for high-impact spikes after meals/snacks
- Target these for nutritional and behavioural interventions



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The role of nutrition for glucose

Protein

- Slows gastric emptying, blunting post-meal glucose spikes.
- Increases satiety and supports weight management.

Fats

- Healthy fats slow glucose absorption, flattening the blood sugar curve.
- Nuts, olive oil and avocado may enhance insulin sensitivity, especially with fibre.

Fibre

- Soluble fibre forms a gel-like barrier that slows absorption and blunts spikes.

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- Eating vegetables first blunts glucose and insulin response, in healthy and metabolically unhealthy populations alike.

Micronutrients

- Magnesium & vitamin K play critical roles in glucose metabolism and insulin action.
- Meal order (veg → protein → carbs) can lower glycaemic response by 30-40%.



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Biofeedback and behaviour change

Data-driven decision



After 10 days of matching CGM data with data about their food and activities, people learnt how to spend more time in a healthy glucose range.



People who saw real-time CGM data were better at sticking to their nutrition plan, lost more weight and saw greater improvement in their metabolic health.



Seeing real-time CGM data helped people re-train hunger cues and lose weight.

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Safeguarding and limitations

Red flags

GOOD CANDIDATES

- Pre-diabetes or elevated fasting glucose.
- Insulin resistance / metabolic syndrome.
- Unexplained fatigue, brain fog, mood dysregulation, poor sleep.
- Weight management plateau despite dietary adherence.
- Obesity with otherwise normal HbA1c.
- Athletes or performance-focused clients.
- Motivated individuals wanting personalised nutrition data.
- Perimenopausal women - oestrogen affects insulin sensitivity.

USE WITH CAUTION OR NOT AT ALL

- History of disordered eating - real-time data may reinforce restriction or anxiety.
- Problematic hypoglycaemia (contraindicated).
- People with clinical diabetes on insulin - wellness CGMs are NOT appropriate substitutes.
- Health anxiety or data fixation - biofeedback may amplify distress.
- Clients who may misinterpret data without practitioner support.
- Note: CGM data is NOT diagnostic - persistent elevations require clinical referral.

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Safeguarding and limitations

Associations between HbA1c and eight CGM metrics across glycemic status.

Cohort (n=972):

- Normoglycemia = 232 (23.9%)
- Pre-diabetes = 319 (32.8%)
- Type 2 diabetes = 421 (43.3%)

Key finding:

- Associations were strongest in type 2 diabetes, with mean glucose showing the strongest relationship ($P < 0.001$).
- In pre-diabetes, associations were substantially attenuated, with mean glucose showing a moderate association ($P < 0.001$).
- Among individuals with normoglycemia, CGM metrics showed minimal associations with HbA1c, with mean glucose demonstrating a weak association ($P = 0.022$) and time in range showing no significant relationship.

Conclusion: Standard CGM metrics should not be interpreted to reflect HbA1c for individuals with pre-diabetes and normoglycemia.



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Case study 1: Symptom-driven decisions

Meet Karen

- Living with pre-diabetes (HbA1c = 44).
- Struggling with low energy, iron deficiency anaemia, cravings, endometriosis, higher body weight than she'd like.
- GP booked her onto the Diabetes programme without speaking to her first following her blood test; she felt very cut off and wanted a conversation.

Action steps:

- Joined "That Blood Sugar Fix" program; began to use a CGM to discover her real-time glucose patterns with my support and explanations.
- CGM revealed frequent spikes, especially when working late into the evening, falling asleep on the sofa and transitioning to the bedroom.
- Small, evidence-based changes guided by the data:
 - Consistent meal pattern, reduce snacking, increase protein and fibre
 - Sleep and work pattern
 - Hydration

6.7 mmol/L
average daily
glucose (CGM)

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Case study 1: Symptom-driven decisions

Karen's results:

- Losing weight - can tell from clothes.
- Not so tired anymore - still addressing iron-deficiency anaemia.
- Has given up crisps, which were a daily staple.
- Hydration has become consistent and feeling the benefits in her workouts.
- A consistent evening routine has meant less snacking and better sleep.

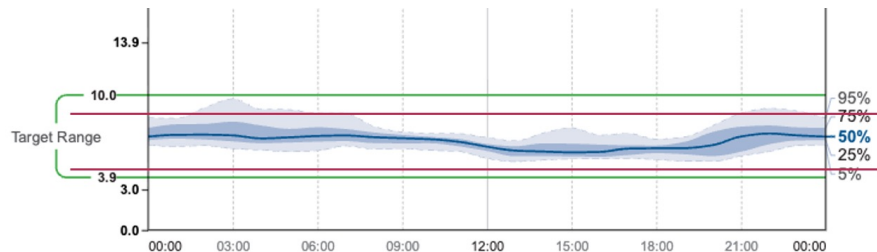
Long-term habits:

- Increase movement and time for self.
- Continuing to work on weight loss.
- The whole family has better meal patterns and structure - no more shopping 3-4 x a week.
- Continued self-monitoring of symptoms and use of a CGM if needed.

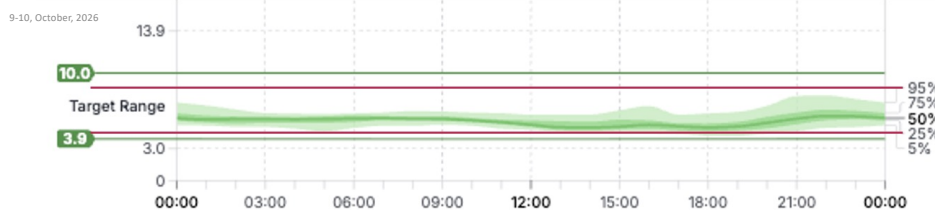
5.6 mmol/L
average daily
glucose (CGM)

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Case study 1: Symptom-driven decisions



6.8 mmol/L
average daily
glucose



5.7 mmol/L
average daily
glucose

35

Case study 2: Symptom-driven decisions

Meet Caroline

- Normoglycaemia/Pre-diabetes (HbA1c = 41/42)
- Struggling with brain fog, low energy, constant hunger, and higher body weight than she'd like.
- Increased HRT didn't resolve symptoms.
- Online advice = "cut all carbs". This advice left her confused and nervous. Caroline feared she'd have no energy if she cut back on carbohydrates.

6.8 mmol/L
average daily
glucose (CGM)

Action steps:

- Joined "That Blood Sugar Fix" program; began to use a CGM to discover her real-time glucose patterns with my support and explanations.
- CGM revealed frequent hidden spikes, which helped connect diet and lifestyle triggers to brain fog and energy dips Caroline was experiencing.
- Small, evidence-based changes guided by the data:
 - Mainly breakfast - increasing to 30g of protein
 - Daily fibre amount

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Case study 2: Symptom-driven decisions

Caroline's results:

- Lost 6kg, down a dress size - even through a holiday.
 - Caroline went on to lose another 6kg across the next 6 months and was the lightest she'd been in 20 years.
- No more afternoon naps; energy and motivation restored.
- Brain fog resolved
- Resting heart rate improved.

Long-term habits:

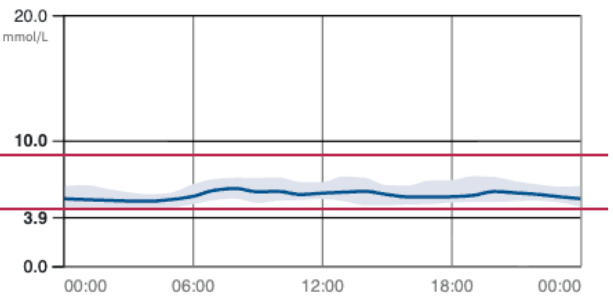
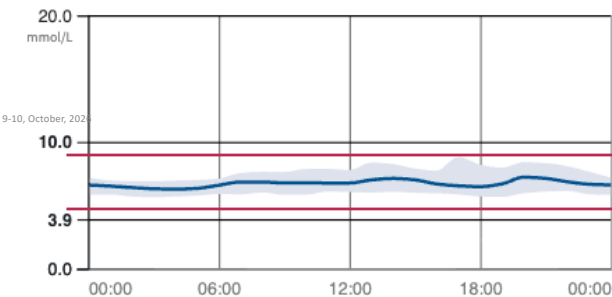
- Increased weight lifting.
- A new way of eating became normal for the whole family.
- Continued self-monitoring of symptoms and use of a CGM if needed.

5.7 mmol/L
average daily
glucose

Case study 2: Symptom-driven decisions

6.8 mmol/L
average daily glucose

5.7 mmol/L
average daily glucose





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Key takeaways for practitioners

Outcomes and Learnings

- Glucose variability is measurable, modifiable, and shows up years before HbA1c or fasting glucose raises concern.
- It's a common holistic pattern across appetite, energy, mood/cognition and vascular ageing.
- Battelino's targets (<5% time above range) give practitioners a validated, actionable threshold.
- CGM-guided nutrition and lifestyle intervention measurably shifts these markers.
- Real-time biofeedback drives sustainable behaviour change.

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Final thought...

Waiting for a pre-diabetes or diabetes diagnosis means missing the window where most of the long-term risk is already accruing.

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So...

Where can CGM and glucose variability tracking fit into your longevity and preventative practice today?



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Thank you. Any

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Longevity and Biological Ageing: Enhancing Health into Advanced Age

Friday 9th October

9-10, October, 2026

Featuring Dr. Jeffrey Bland, Professor Helene McNulty, Natalie Burrows, Professor Anna Nicolaou, Dr. Sally Moorcroft, Dr. Nina Fuller-Shavel and Dr. Laurens Maas

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