



**PARIS
MASH
MEETING**

10th edition

**Organized by
Arun Sanyal & Lawrence Serfaty**



**September 5 & 6 2024
Institut Pasteur, Paris**

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What is the future of wearables in managing MASLD and metabolic health?

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Disclosures

- I used Open.AI to support in the preparation of this talk
- Consultant: Alentis, Alexion, Altimune, Astra Zeneca, 89Bio, Bionorica, Boehringer Ingelheim, Gilead Sciences, GSK, Ipsen, Inventiva Pharma, Madrigal Pharmaceuticals, Lilly, MSD, Northsea Therapeutics, Novartis, Novo Nordisk, Pfizer, Roche, Sanofi, and Siemens Healthineers
- Stock Options: AGED diagnostics, Hepta Bio
- Speaker Honorarium: AbbVie, Boehringer Ingelheim, Echosens, Gilead Sciences, MedScape, Novo Nordisk, Madrigal Pharmaceuticals.

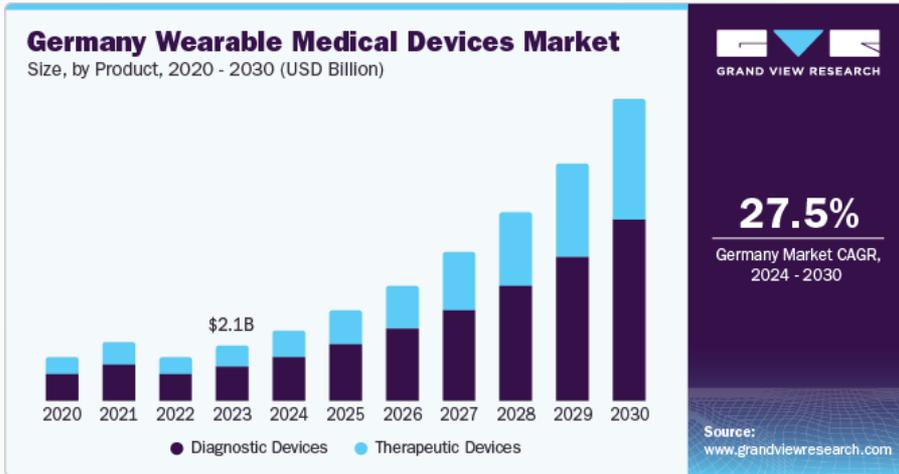
Present state of Wearables in Metabolic Disease Management

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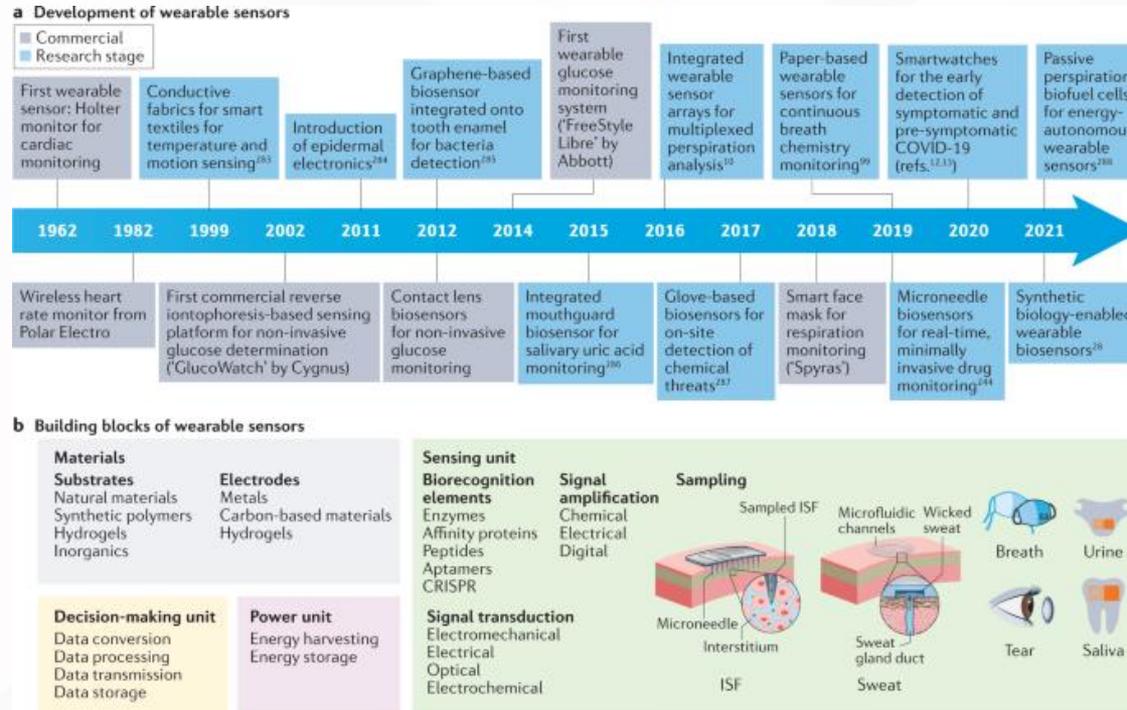
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Broad uptake of wearable medical devices



Type	category
<i>diagnostic devices</i>	vital sign monitoring
	sleep monitoring
	fetal and obstetric
	neuromonitoring
<i>therapeutic devices</i>	pain management
	glucose monitoring w/wo Insulin therapy
	rehabilitation devices
	respiratory therapy devices

Health technology driven by sensor development



Broad uptake of wearables in everyday life

Feb. 8, 2021

WELL

Can Technology Help Us Eat Better?

A new crop of digital health companies is using blood glucose monitors to transform the way we eat.

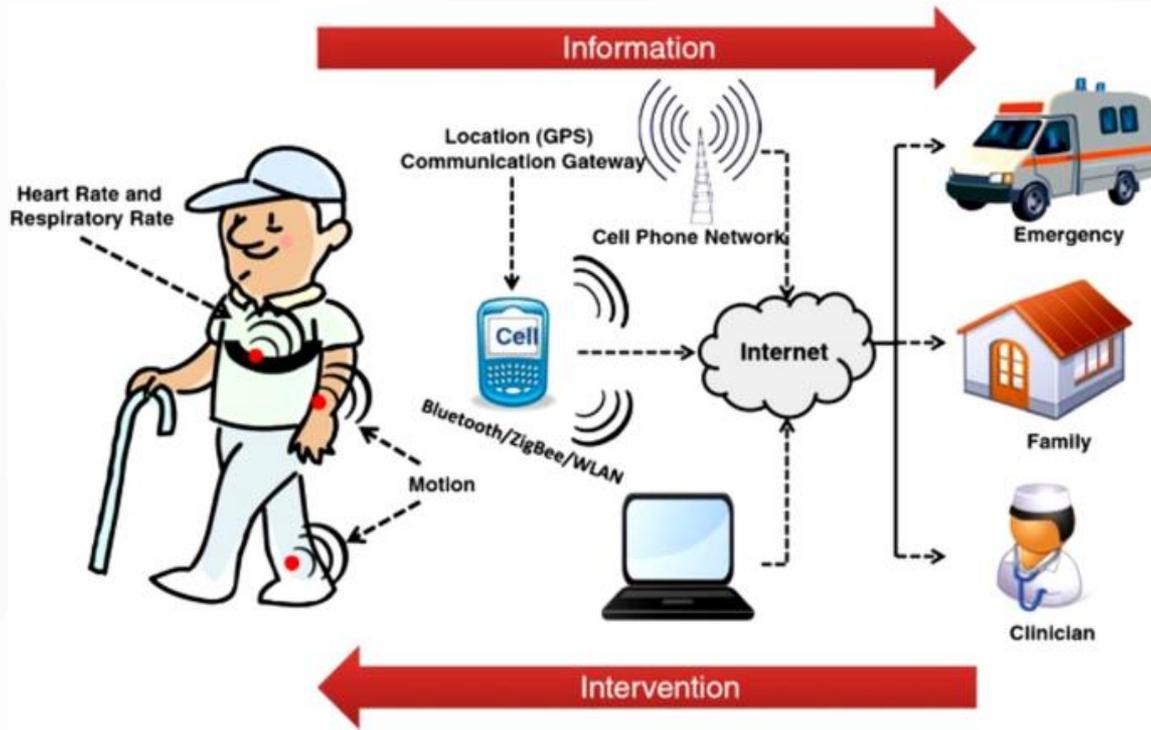
By Anahad O'Connor

PRINT EDITION Checking Your Blood Sugar? It's on Your Phone | February 9, 2021, Page D6



- 1. Health and Fitness Monitoring**
- 2. Workplace Productivity** (Task Management; Safety and Efficiency)
- 3. Personal Convenience** (Payments, Smart home)
- 4. Entertainment and Communication**
- 5. Medical Applications**
- 6. Fashion and Self-Expression**
- 7. Sports and Recreation**
- 8. Environmental Awareness**

Integration in Digital Health Services



- patients with chronic metabolic diseases, wearables facilitate remote monitoring
- adjustments to treatment
- reduction of in-person visits
- improving access to care – elderly population
- reduce pressure in burdened health care systems

Building evidence on the value of wearables in medical decision making

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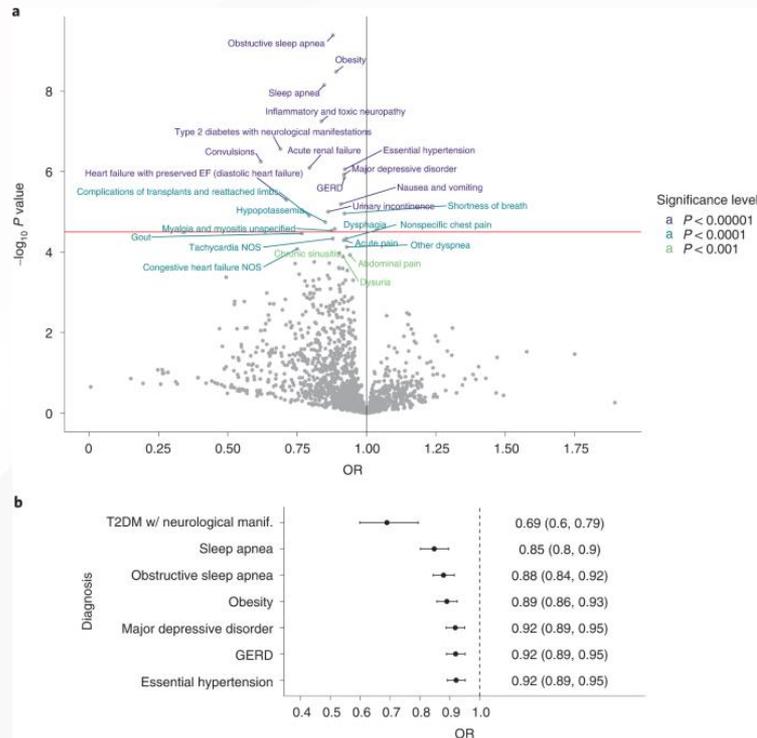
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Association of step counts over time with the risk of chronic disease in the *All of Us* Research Program

[Hiral Master](#), [Jeffrey Annis](#), [Shi Huang](#), [Joshua A. Beckman](#), [Francis Ratsimbazafy](#), [Kayla Marginean](#), [Robert Carroll](#), [Karthik Natarajan](#), [Frank E. Harrell](#), [Dan M. Roden](#), [Paul Harris](#) & [Evan L. Brittian](#) ✉

Nature Medicine **28**, 2301–2308 (2022) | [Cite this article](#)

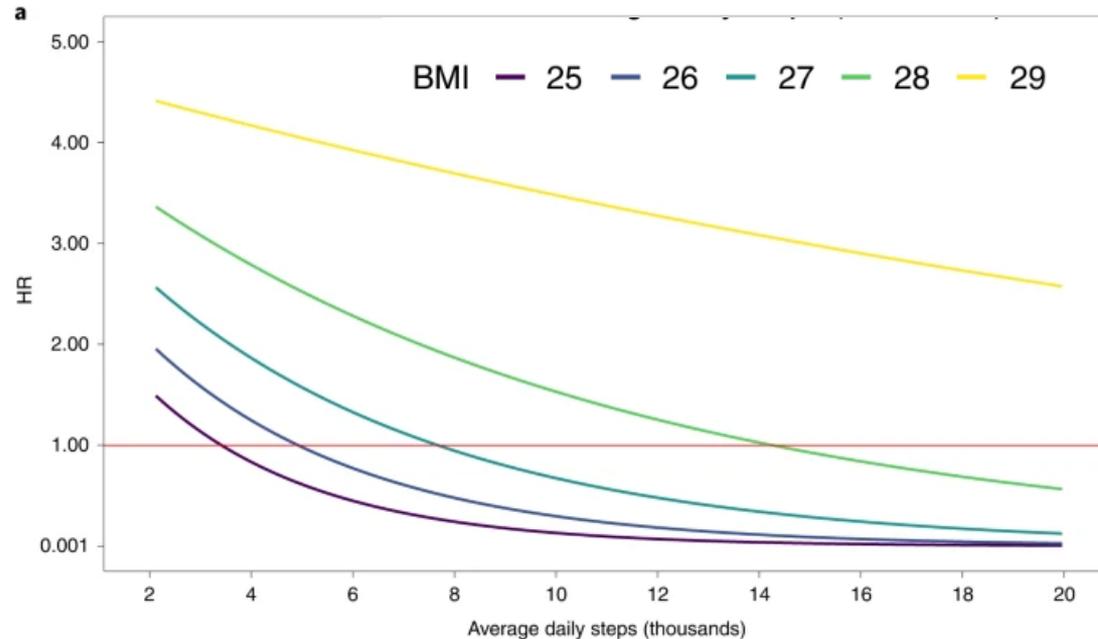
- electronic health records from the All of Us Research Program (n= 6,042 participants)
- Step count captured by participants' own Fitbit devices are associated with
- risk of chronic disease across the entire human phenome.



association of increasing daily step counts with outcomes

Wearables are able to assess risk factors of SLD

Fig. 3: Relation between daily step counts and incident risk of obesity. ➤ at 5 years



- Relationships with incident diabetes (n = 156) and hypertension (n = 482)
- nonlinear with no further risk reduction above 8,000–9,000 steps

Activity Level and MASLD

LIVER

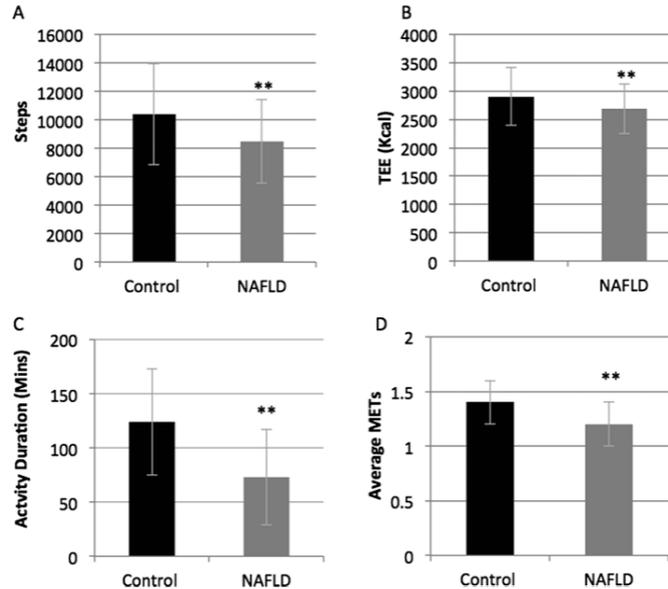


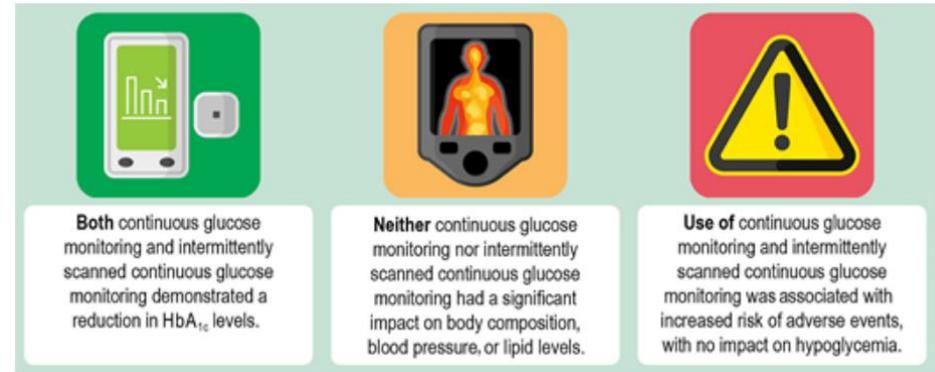
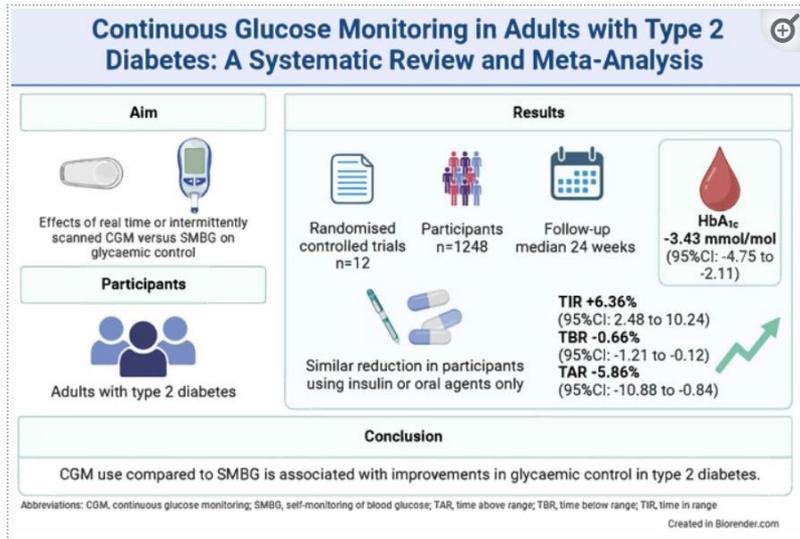
Figure 1 Objectively measured physical activity levels were lower in non-alcoholic fatty liver disease (NAFLD) compared with healthy controls (data reported as daily means (SD)). (A) Steps. (B) Total energy expenditure. (C) Physical activity duration. (D) Average MET levels.



SenseWear Pro3
Bodymedia

How about monitorin glucose levels?

CGM in T2D in studies with an intervention



- ❖ 26 RCTs (17 CGM and 9 isCGM) involving 2,783 patients with T2D

Outcomes data?

Am J Perinatol 2024; 41(S 01): e1370-e1377
DOI: 10.1055/s-0043-1764208



Original Article

Continuous Glucose Monitoring and Time in Range: Association with Adverse Outcomes among People with Type 2 or Gestational Diabetes Mellitus

Ghamar Bitar , Joycelyn A. Cornthwaite, Sandra Sadek, Tala Ghorayeb, Nahla Daye, Sarah Nazeer, Danna Ghafir, John Cornthwaite, Suneet P. Chauhan, Baha M. Sibai, Michal Fishel Bartal

Key Points

- Time in range can be utilized as a metric for pregnant patients using continuous glucose monitor.
- Time in range >70% is achievable by 6 out of 10 patients.
- Time in range below goal is associated with adverse neonatal and maternal outcomes.

CGM – recommendations on the use in clinical trials

	Measures	Aim
Percentage of sensor data obtained	The proportion of possible obtained readings by the CGM device; provides a measure of confidence in the all data-derived metrics	>70% of data during the collection period
Frequency of scanning (eg, scans per day)	For FreeStyle Libre and FreeStyle Libre 2 systems, the sensor should be scanned periodically with a reader or the smartphone app; the frequency of scanning is associated with changes in glucose metrics ⁴⁴	Frequency of minimum once every 8 h to ensure no gaps in data
Time in ranges		
Time in range	Measures the percentage of time spent in consensus target glucose range	>70% of time per day (ie, 16 h 48 min) in type 1 diabetes; >50% of time per day (12 h) in type 2 diabetes

Units and quantity		
Core endpoints		
Time in range 70–180 mg/dL (3.9–10.0 mmol/L)	Percentage of time in range; amount of time (hours and minutes)	>70% of time per day (ie, 16 h 48 min) in type 1 diabetes; >50% of time per day (12 h) in type 2 diabetes
Time below range <70 mg/dL (<3.9 mmol/L), including readings of <54 mg/dL (<3.0 mmol/L)	Percentage of time below range; amount of time (hours and minutes)	<1% of time per day (15 min) in people aged 60 years or patients at high risk of hypoglycaemia
Time below range <54 mg/dL (<3.0 mmol/L)	Percentage of time below range; amount of time (hours and minutes)	<1% of time per day (15 min) in type 1 and type 2 diabetes
Time above range >180 mg/dL (>10.0 mmol/L), including readings of >250 mg/dL (>13.9 mmol/L)	Percentage of time above range; amount of time (hours and minutes)	<10% of time per day (2 h 24 min) in people aged 60 years or patients at high risk of hyperglycaemia
Time above range >250 mg/dL (>13.9 mmol/L)	Percentage of time above range; amount of time (hours and minutes)	<10% of time per day (2 h 24 min) in type 1 and type 2 diabetes
Coefficient of variation	Percentage coefficient of variation intraday (ie, within 24 h) and interday (ie, over multiple days)	<36% of glucose variability in type 1 diabetes
SD of mean glucose	SD	<10% of time per day (2 h 24 min) in type 1 and type 2 diabetes
Mean sensor glucose	mg/dL (mmol/L)	<10% of time per day (2 h 24 min) in type 1 and type 2 diabetes

Glucose Management Indicator	A measure of short-term glucose levels that can be used to predict long-term glucose exposure; the Glucose Management Indicator is expressed in the same units as HbA _{1c} (eg, as a percentage or mmol/mol) for comparative purposes, but they are usually not identical	No international consensus recommendations
Coefficient of variation	A measure of dynamic glucose variability expressed as percentage coefficient of variation and calculated as $100 \times (\text{SD} \div \text{mean glucose})$; coefficient of variation is correlated with time below range	<36% of glucose variability in type 1 diabetes
SD of mean glucose	The SD of mean glucose values is a measure of dynamic glucose variability; SD is strongly correlated with mean glucose	No international consensus recommendations

Each of these measures of glucose control can be derived and reported by CGM devices. They are all endorsed by international consensus guidance on the use of CGM devices in the management of diabetes.⁴⁴

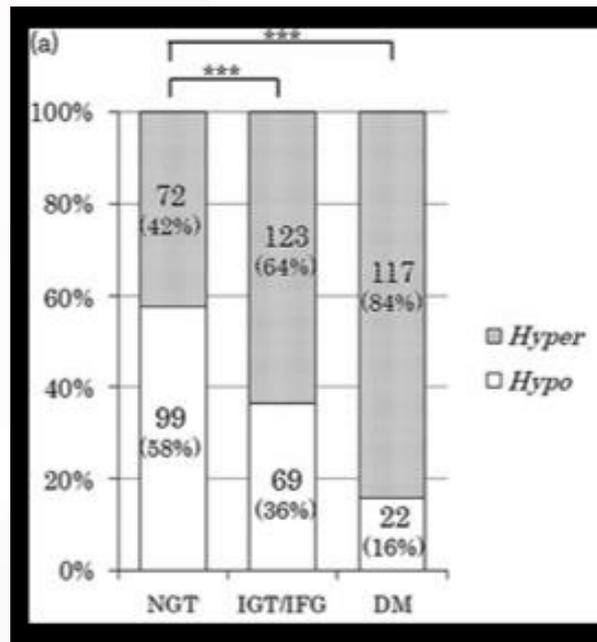
Table 2: Objective measures of glycaemic control derived from CGM devices

✓ To optimise study objectives consideration to the selection and use of CGM devices are needed

Evidence in Liver disease?

CGM in MASLD – hypoglycemia episodes

	Total (N= 502)
Sex (female/male)	197/305
Age (years)	53.38 ± 15.13
BW (kg)	75.95 ± 15.26
BMI (kg/m ²)	28.43 ± 4.64
AST (IU/l)	53.36 ± 30.37
ALT (IU/l)	89.59 ± 53.51
ALP (IU/l)	247.20 ± 117.48
GGT (IU/l)	82.68 ± 72.20
T-Bil (mg/dl)	0.91 ± 0.37
HbA1c (%)	6.00 ± 0.82
HOMA-IR	4.03 ± 3.19
Histological findings	
Fibrosis (F0/F1/F2/F3/F4)	21/150/197/124/10
Steatosis (G1/G2/G3)	249/141/112



CGM users and oGTT

Comparison of normal glucose tolerance vs abnormal (IFG or T2D)

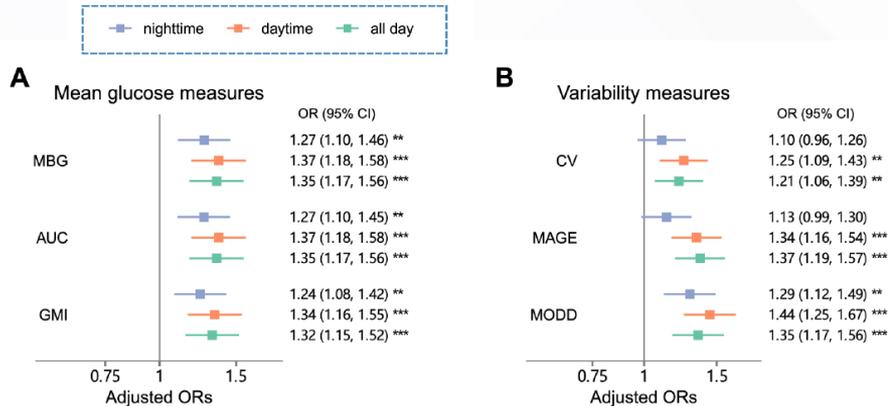
- proportion of patients in the Hypo subgroup
 - ❖ insulin secretion was higher
 - ❖ FPG and hemoglobin A1c (HbA1c) were lower

✓ Postprandial hypoglycemia in CGM users could detect MASLD patients

Hepatic steatosis and CGM metrics

- cross-sectional study (n=1180)
- CGM and MRI-PDFF (healthy: n = 698; mild steatosis: n = 242; moderate/severe steatosis: n = 240)

- ✓ higher CGM-derived mean glucose and variability metrics in higher degree of hepatic steatosis
- ✓ CGM-derived metrics during the nighttime and daytime periods with unique information
- ✓ strategies for identification of hepatic steatosis via precision glycemic management



MBG: mean blood glucose
AUC: glucose area under the curve
GMI: glucose management indicator

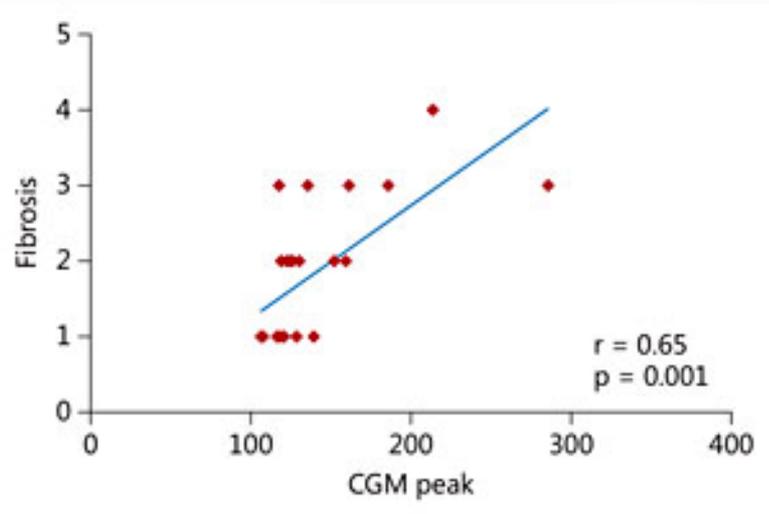
CV: coefficient of variation
MAGE: mean amplitude of glycemic excursions
MODD: mean of daily differences

Glucose profile in children associated with the hepatic fibrosis

N=30

Age, years	12.87±2.19
BMI	24.40±4.06
Waist circumference, cm	85.12±7.91
z-BMI	3.48±0.93
AST, IU/l	26±4.89
ALT, IU/l	23.65±12.26
Total cholesterol, mg/dl	154.53±33.54
LDL cholesterol, mg/dl	93.89±28.23
HDL cholesterol, mg/dl	48.76±12.29
TG, mg/dl	76.19±29.81
FPG, mg/dl	77.61±9.66
FPG at 120 min, mg/dl	106.34±22.48
Insulin, mU/l	23.27±20.01
Insulin at 120 min, mU/l	95.97±48.86
HOMA-IR	4.59±4.24
HbA1c, mmol/mol	34.08±1.79
Uric acid, mg/dl	5.01±1.43
Peak CGM, mg/dl	140.32±39.34
Mean CGM, mg/dl	92.64±18.53

Values are mean ± SD. BMI = Body mass index; z-BMI = z-score body mass index.



Patient and provider perspective

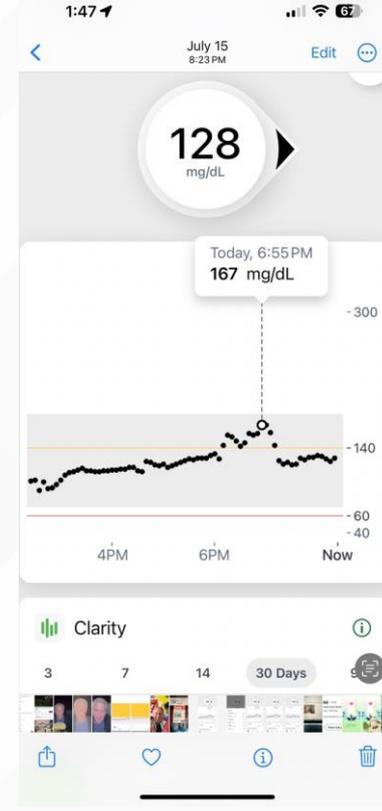
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Enhance Engagement and personalize Health Insights

- wearables can provide personalized insights
- customization helps understand the unique metabolic profiles
- Allow for informed decisions about their lifestyle choices



What do providers think?

[J Diabetes Sci Technol](#). 2023 Sep; 17(5): 1265–1273.

Published online 2022 Apr 11. doi: [10.1177/19322968221088267](https://doi.org/10.1177/19322968221088267)

PMCID: PMC10563522

PMID: [35403469](https://pubmed.ncbi.nlm.nih.gov/35403469/)

Diabetes Specialists Value Continuous Glucose Monitoring Despite Challenges in Prescribing and Data Review Process

[Tejaswi Kompala](#), MD,¹ [Jenise Wong](#), MD, PhD,² and [Aaron Neinstein](#), MD^{1,3}

Table 4.

Facilitators of and Barriers to CGM Provision and Data Use by Providers (CFIR) (n = 87).

CFIR Domain	Themes	Representative quotes
Intervention characteristics: Facilitators CGM as a technology	<ul style="list-style-type: none">• Comprehensive continuous data• Real-time BG values facilitate behavior change• Reduction of serious hypoglycemia• Automatic upload	<ul style="list-style-type: none">• “One of the tools that makes it easier for patients to do better with less interference in their lives. Alarms protect from lows and alert to act on highs”• “[CGM] provides a wealth of data”• “Ability to see real time data without upload required”

Challenges and Perspective



Which future have wearables in managing MASLD ?

- Technology advancement will move wearables into Hepatology and MASLD
- **Improved Sensor Technology**
- **Artificial Intelligence** enabling proactive health management.
- **Telehealth Integration with** seamless integration into “health platforms” to allow for communication and feedback

Wearables will keep Hepatology a busy practice!



- CLM: continuous liver monitoring



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