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Freestyle Libre

Dr Rachel Troke

16/09/2021

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Diabetes Care Volume 43, September 2020

Effect of Flash Glucose Monitoring on Glycemic Control, Hypoglycemia, Diabetes-Related Distress, and Resource Utilization in the Association of British Clinical Diabetologists (ABCD) Nationwide Audit

Harshal Deshmukh,[1] Emma G. Wilmot,[2] Robert Gregory,[3] Dennis Barnes,[4] Parth Narendran,[5] Simon Saunders,[6] Niall Furlong,[7] Shafie Kamaruddin,[8] Rumaisa Banatwalla,[9] Roselle Herring,[10] Anne Kilvert,[11] Jane Patmore,[1] Chris Walton,[1] Robert E.J. Ryder,[12] and Thozhukat Sathyapalan[1]

Diabetes Care 2020;43:2153–2160 | https://doi.org/10.2337/dc20-0738

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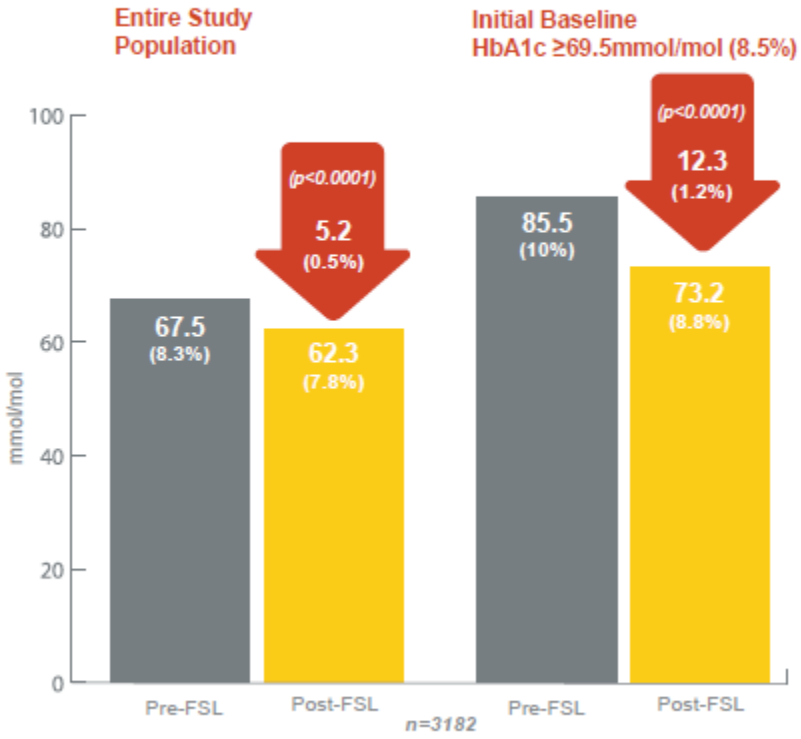
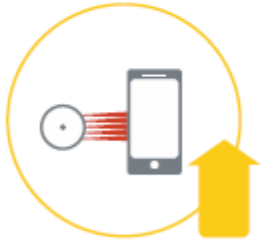
The FreeStyle Libre system is associated with significantly improved glycaemic control as measured by HbA1c



Predictors of HbA1c reduction:

- Higher baseline HbA1c
- A greater number of scans per day

Mean daily scans



12.9 per day

Diabetes Care 2020;43:1–8 | https://doi.org/10.2337/dc20-0738

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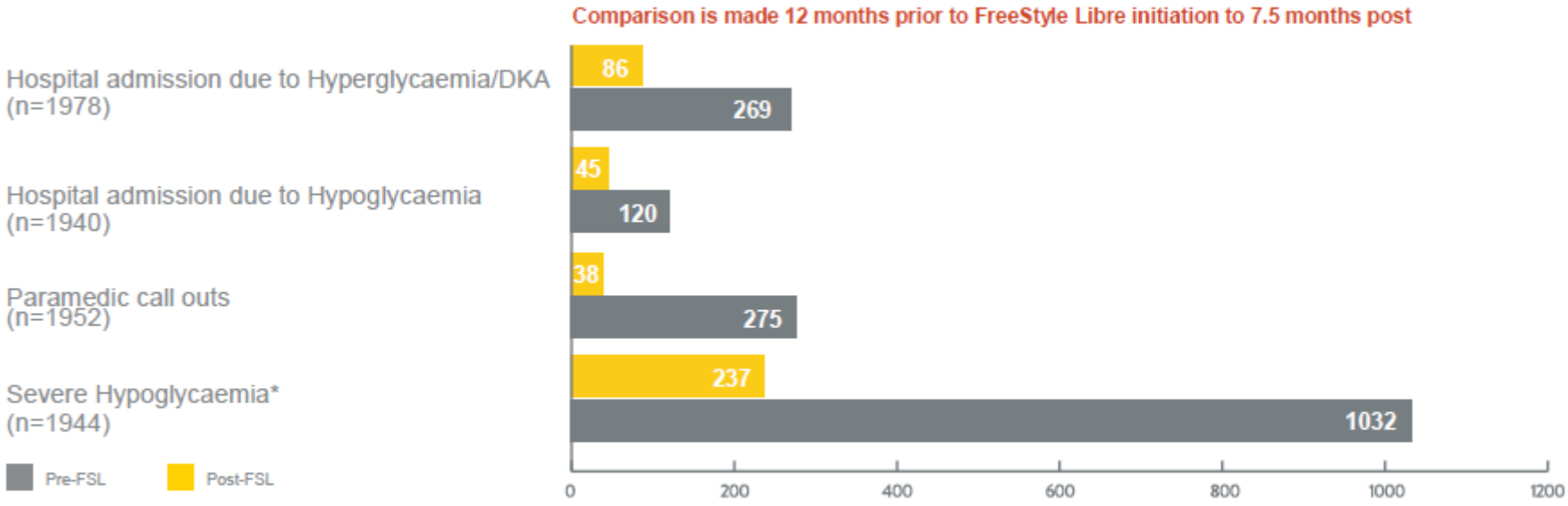
The FreeStyle Libre system users had significantly less paramedic call outs, hospital admissions and episodes of severe hypoglycaemia in the 7.5 month follow up period



*those events requiring third party assistance

NHS RESOURCE UTILISATION REDUCTION SEEN ACROSS ALL MEASURES

Diabetes Care 2020;43:1–8 | https://doi.org/10.2337/dc20-0738

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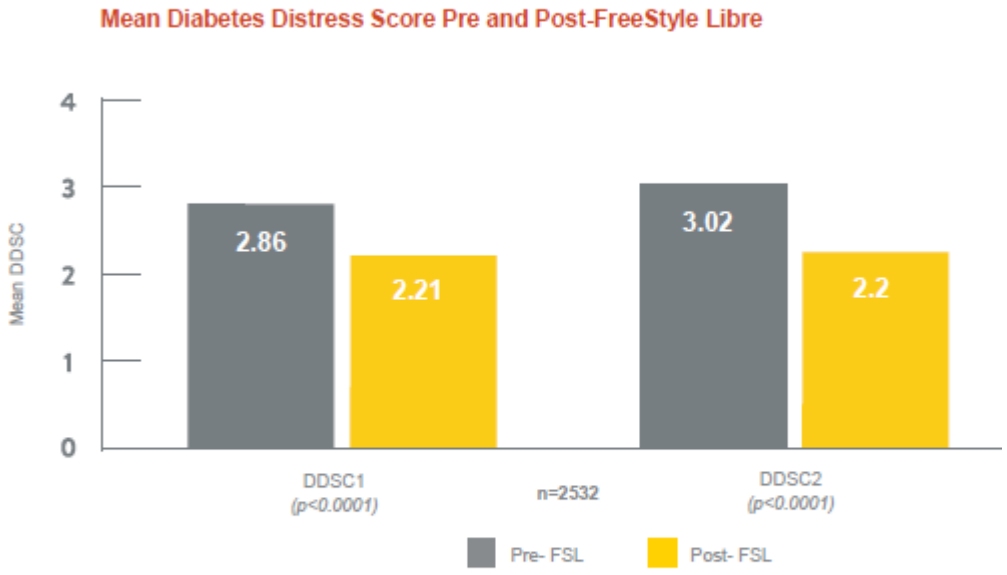
The FreeStyle Libre system is associated with a significantly improved diabetes distress score

	Not a Problem	A Slight Problem	A Moderate Problem	Somewhat Serious Problem	A Serious Problem	A Very Serious Problem
1. Feeling overwhelmed by the demands of living with diabetes.	1	2	3	4	5	6
2. Feeling that I am often failing with my diabetes routine.	1	2	3	4	5	6



IMPROVEMENTS IN BOTH COMPONENTS OF DIABETES DISTRESS WERE REPORTED

Diabetes Care 2020;43:1–8 | https://doi.org/10.2337/dc20-0738

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The FreeStyle Libre system is associated with significantly improved hypoglycaemic awareness and reductions in patient reported hypoglycaemia

Gold Questionnaire

"Do you know when your hypos are commencing?"

A score of 4 or greater suggests impaired awareness

n=2801

Reduced from 2.7 to 2.4 (*p<0.0001*)

53% of those with a score ≥4 at baseline had a score <4 at follow up

of users able to reduce rate of hypoglycaemia

of users able to reduce proportion of time in hypoglycaemia

of users able to reduce rate of nocturnal hypoglycaemia

Diabetes Care 2020;43:1–8 | https://doi.org/10.2337/dc20-0738

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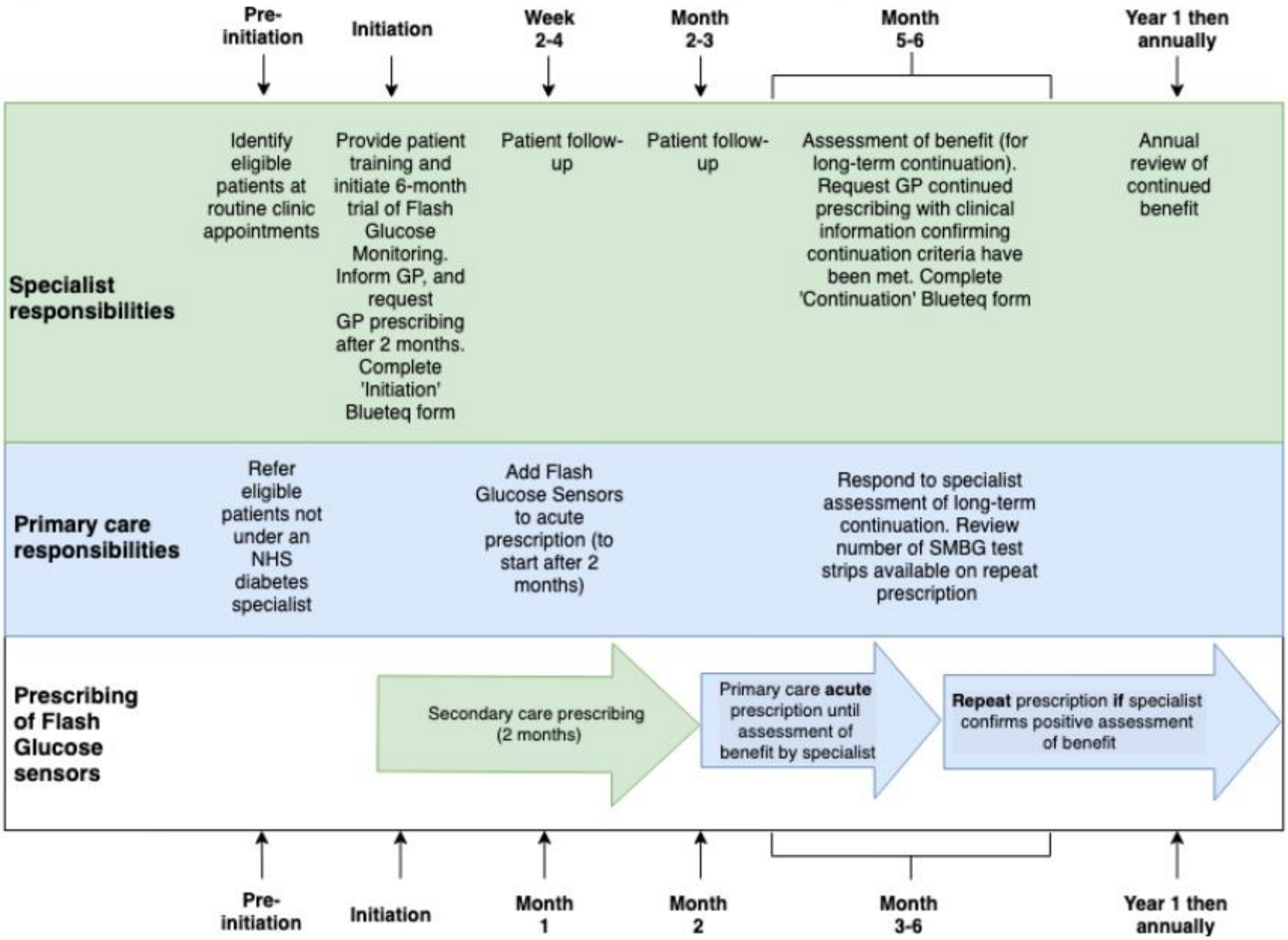
- Eligibility Criteria (CCG)
  - Type 1 diabetes needing to test > 8 x per day
  - Any diabetes on HD needing to test >8 x per day
  - Diabetes associated with CF and on insulin treatment
  - Type 1 diabetes and pregnant (12m funding)
  - Type 1 diabetes unable to self monitor due to disability
  - Type 1 diabetes & occupation
  - Psychosocial
  - Previous self funder who would meet current criteria for Libre AND has shown HbA1c improvement
  - Type 1 and impaired awareness of hypoglycaemia
  - Type 1 diabetes or insulin treated Type 2 diabetes living with a learning disability

Appendix 2 - Summary of process for initiation and supply of FreeStyle Libre/Libre 2®



(Process map [with adaptations] used with the permission of NCL CCG)

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Time in range

DIABETIC Medicine

REVIEW ARTICLE

Time in range: A best practice guide for UK diabetes healthcare professionals in the context of the COVID-19 global pandemic

E. G. Wilmot[1,2] | A. Lumb[3,4] | P. Hammond[5] | H. R. Murphy[6,7] | E. Scott[8] | F. W. Gibb[9,10] | J. Platts[11] | P. Choudhary[12,13]

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TABLE 1 Objective measures of glycaemic control derived from real-time continuous glucose monitoring (CGM) and intermittently scanned CGM data

Metric	What does it measure?
Percentage of sensor data captured	Proportion of possible readings captured by the rtCGM or isCGM device. Provides a measure of confidence in the other data-derived outcomes.
TIR measures	
TIR	Percentage of time spent in the target glucose range set on the rtCGM or isCGM system: defined as 3.9–10.0 mmol/l.
TBR	Percentage of time spent below the target glucose range set on the rtCGM or isCGM system: defined as below 3.9 mmol/l.
TAR	Percentage of time spent above the target glucose range set on the rtCGM or isCGM system: defined as above 10.0 mmol/l.
eA_{1c}/GMI	Short-term glucose exposure that can be used in conjunction with long-term HbA_{1c} in setting goals.
Mean glucose	Average glucose level calculated across the recorded glucose readings over a defined period.
Standard deviation	Variability (highly influenced by mean glucose).
CV	Variability that is less influenced by mean glucose. Expressed as %CV, calculated as 100 × (SD/mean glucose)

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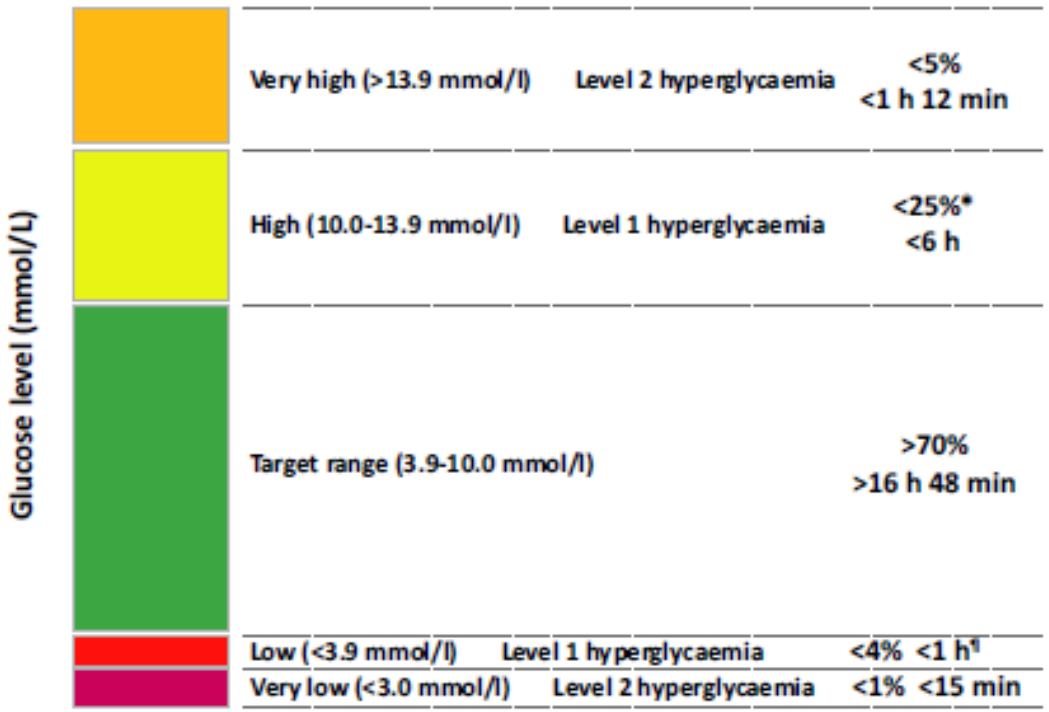

* Readings >13.9 mmol/l are also included in the <25% target
Readings <3.0 mmol/l are also included in the <4% target

Thinking about individualised targets

A person with **HbA1c of 53-63 mmol/mol (7.0-7.9%)** will see on average a **4 mmol/mol (0.4%) reduction** with each **10% (2 h 24 min) increase in TIR**

A person with **HbA1c of ≥64 mmol/mol (≥ 8.0%)** can see on average a 11 mmol/mol (1.0%) reduction in HbA1c with each **10% (2 h 24 min) increase in TIR**

A **10% (2 h 24 min) decrease in TAR** can be associated on average with a **reduction in HbA1c of approx 7 mmol/mol (0.6%)**

For **age <25 years with type 1 diabetes, if the HbA1c goal is 58 mmol/mol (7.5%), set TIR target to approx 60%**

FIGURE 1 Time in ranges: targets for people with type 1 or type 2 diabetes. TAR, time above range; TIR, time in range

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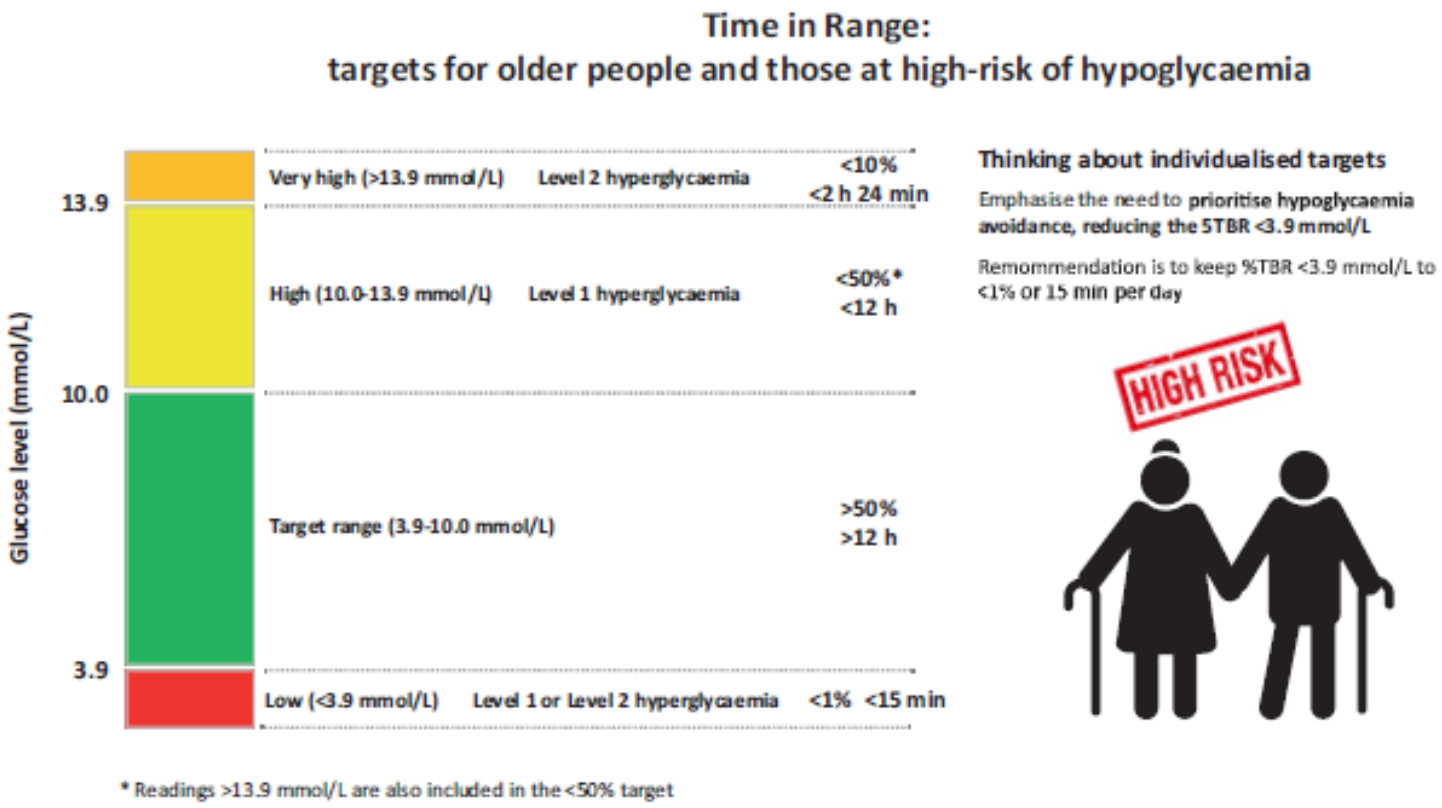

FIGURE 3 Time in ranges: targets for older people with type 1 or type 2 diabetes and those at high risk from hypoglycaemia. TBR, time below range

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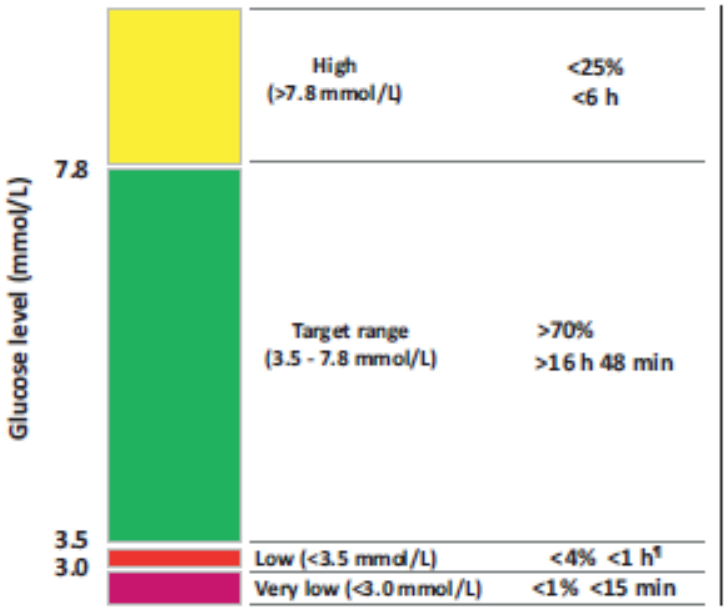
Time in Range:
targets for women with type 1 diabetes who are pregnant*



Thinking about individualised targets

Women with T1D should aim dor a **daily TIR of >70% (16 h 48 min)** from as **early as possible during pregnancy**

Women with T1D should aim for a **daily TAR >7.8 mmol/L of <25% (<6 h)**, from **as early as possible during pregnancy**

A **5% (1 h 12 min) increase in TIR** during the **2nd and early 3rd trimester** is associated with **clinically relevant improvements in neonatal health**

During pregnancy the %TIR should be considered in conjunction with mean daily glucose, aiming for a **mean glucose of 6.0 - 6.5 mmol/L**

* %TIR, %TBR and %TAR are based on limited evidence. More research is needed.
¶ Readings <3.0 mmol/L are also included in the <4% target

FIGURE 4 Time in ranges: targets for women with type 1 diabetes who are pregnant or planning pregnancy. TAR, time above range; TBR, time below range; TIR, time in range

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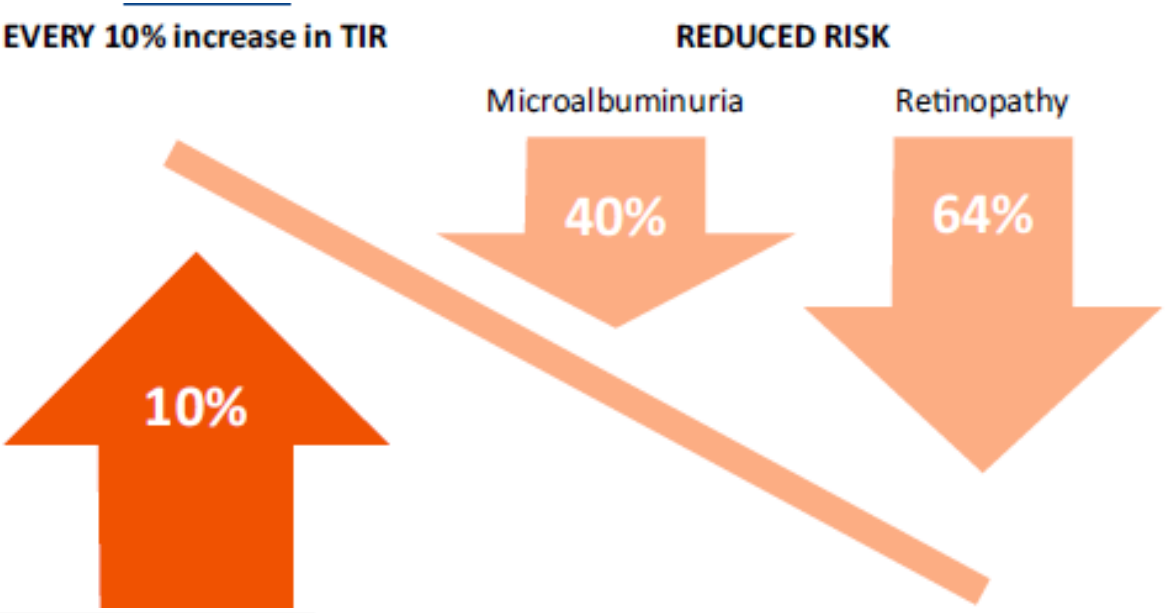

TIR, %	Predicted HbA_{1c}[†]	
	mmol/mol	%
90	42 (28, 56)	6.0 (4.7, 7.3)
80	48 (33, 62)	6.5 (5.2, 7.8)
70	53 (38, 67)	7.0 (5.6, 8.3)
60	57 (43, 73)	7.4 (6.1, 8.8)
50	63 (49, 77)	7.9 (6.6, 9.2)
40	68 (54, 83)	8.4 (7.1, 9.7)
30	74 (60, 88)	8.9 (7.6, 10.2)
20	78 (64, 93)	9.4 (8.0, 10.7)

Diabetes Care 2018;42:400–405; Lu J et al. *Diabetes Care* 2018;41:2370–2376

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- Strengths
  - Dynamic
  - Easy to track
  - Can be visualised
  - Can be personalised
  - Directly actionable in real time
  - Allows goal setting

- Considerations
  - It's a new way of thinking, we don't have the correlations with complications
  - Should be used together with other measures in making treatment decisions
  - Improving %TIR (like HbA1c) should not be at the expense of %TBR

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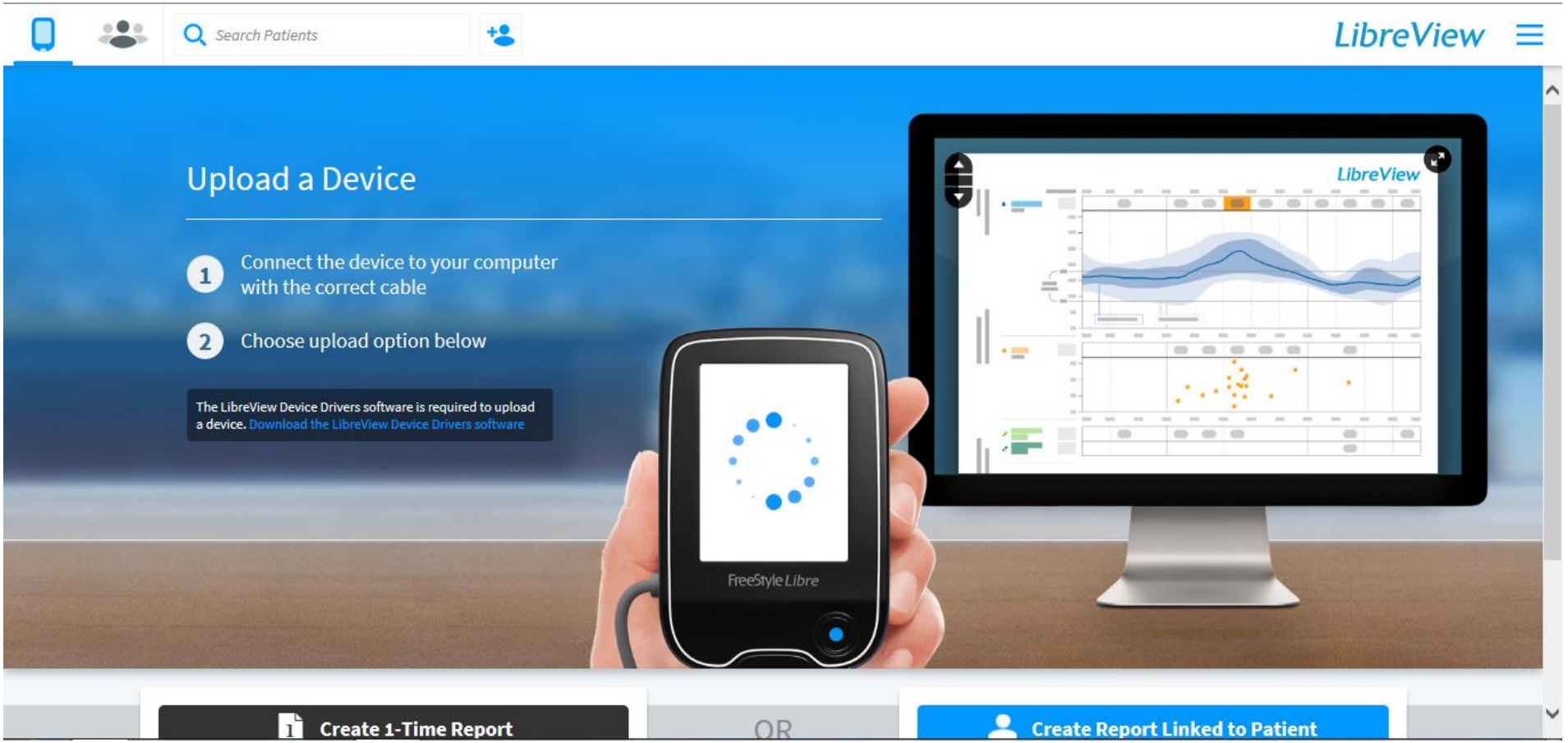
Libre View



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AGP Report

20 May 2021 - 2 June 2021 (14 Days)

LibreView

GLUCOSE STATISTICS AND TARGETS

20 May 2021 - 2 June 2021	**14 Days**
% Time Sensor is Active	**41%**

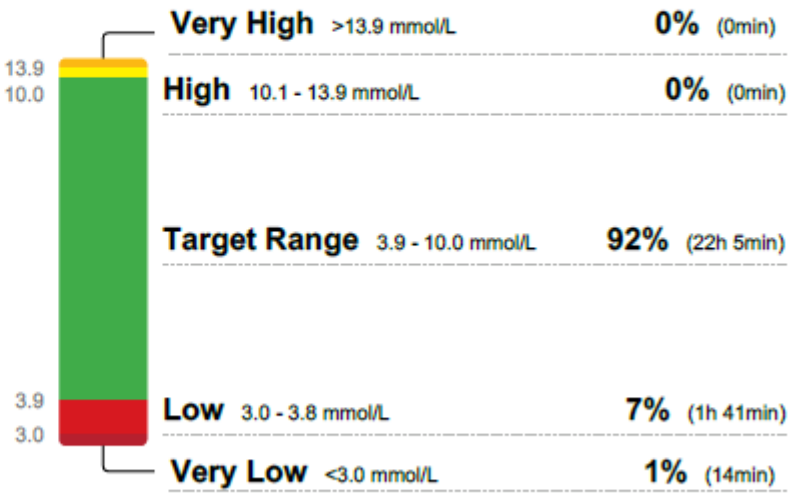
Ranges And Targets For	Type 1 or Type 2 Diabetes
Glucose Ranges Target Range 3.9-10.0 mmol/L	**Targets** % of Readings (Time/Day) Greater than 70% (16h 48min)
Below 3.9 mmol/L	Less than 4% (58min)
Below 3.0 mmol/L	Less than 1% (14min)
Above 10.0 mmol/L	Less than 25% (6h)
Above 13.9 mmol/L	Less than 5% (1h 12min)

Each 5% increase in time in range (3.9-10.0 mmol/L) is clinically beneficial.

Average Glucose	**4.9** mmol/L
Glucose Management Indicator (GMI)	**5.4% or 36 mmol/mol**
Glucose Variability	**15.8%**

Defined as percent coefficient of variation (%CV); target ≤36%

TIME IN RANGES



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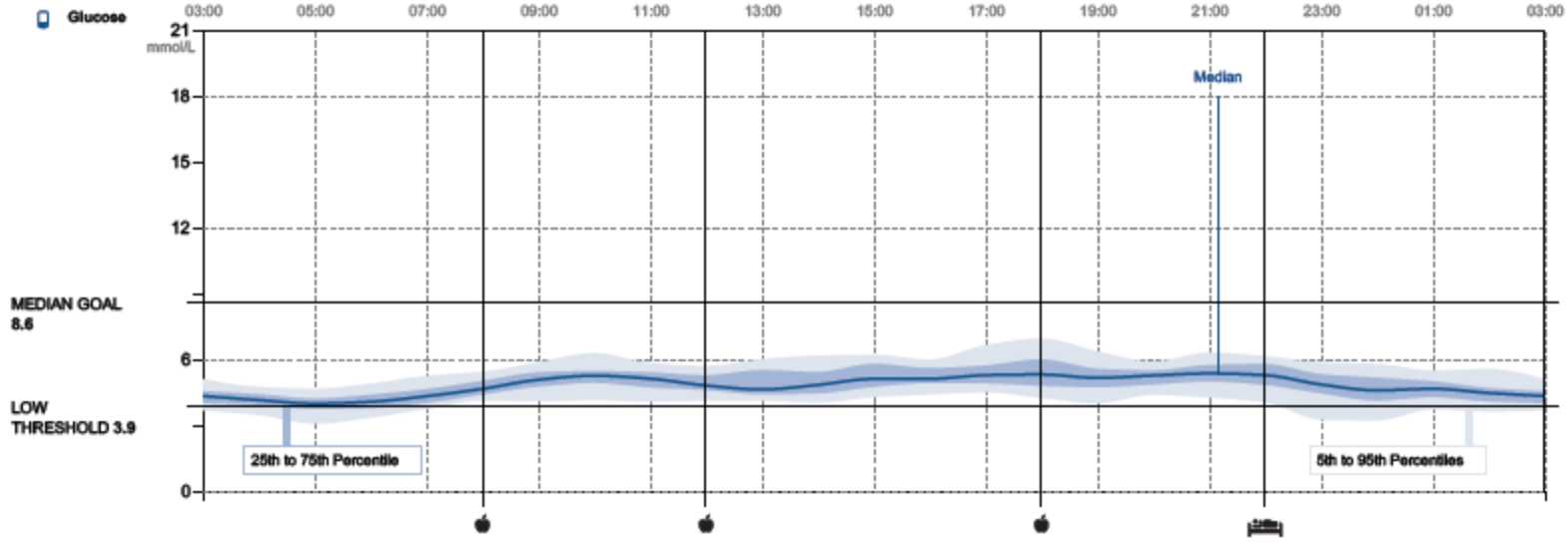
Glucose Pattern Insights

20 May 2021 - 2 June 2021 (14 Days)

LibreView

GMI 5.4 % or 36 mmol/mol



Likelihood of LOW GLUCOSE					
MEDIAN GLUCOSE Compared to goal	OK	OK	OK	OK	OK
VARIABILITY BELOW MEDIAN Median to 10th percentile	OK	OK	OK	OK	OK

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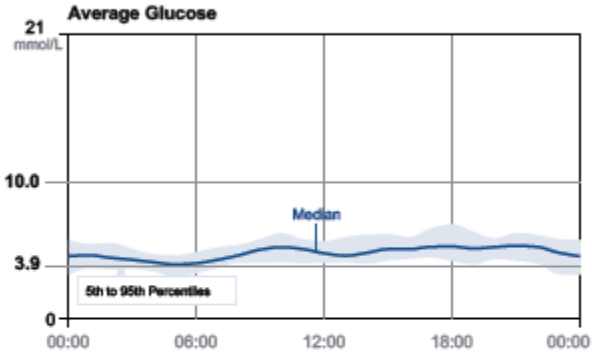
Snapshot

20 May 2021 - 2 June 2021 (14 Days)

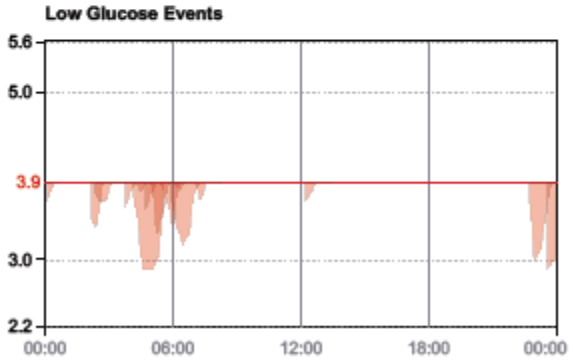
Glucose

GMI 5.4 % or 36 mmol/mol

AVERAGE GLUCOSE	4.9 mmol/L
% above target	0 %
% in target	92 %
% below target	8 %



LOW GLUCOSE EVENTS	8
Average duration	149 Min



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Case 1

AGP Report

2 March 2021 - 15 March 2021 (14 Days)

LibreView

GLUCOSE STATISTICS AND TARGETS

2 March 2021 - 15 March 2021	**14 Days**
% Time Sensor is Active	**97%**

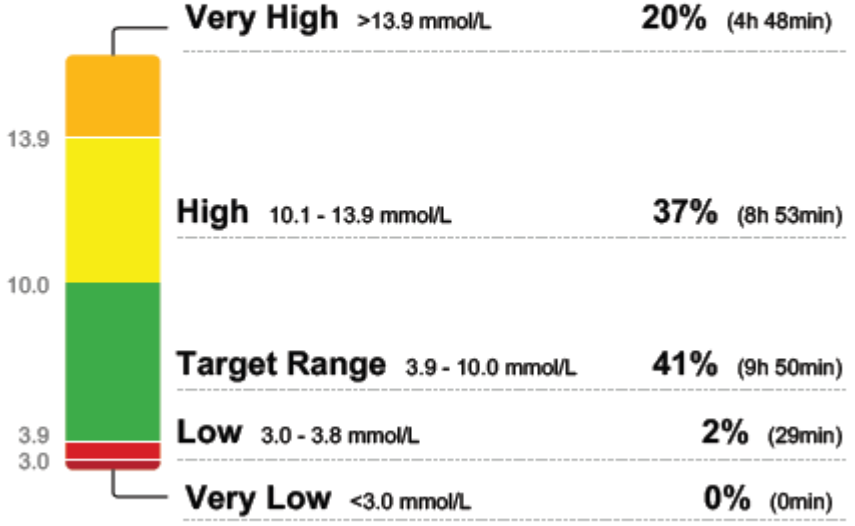
Ranges And Targets For	Type 1 or Type 2 Diabetes
Glucose Ranges	**Targets** % of Readings (Time/Day)
Target Range 3.9-10.0 mmol/L	Greater than 70% (16h 48min)
Below 3.9 mmol/L	Less than 4% (58min)
Below 3.0 mmol/L	Less than 1% (14min)
Above 10.0 mmol/L	Less than 25% (6h)
Above 13.9 mmol/L	Less than 5% (1h 12min)

Each 5% increase in time in range (3.9-10.0 mmol/L) is clinically beneficial.

Average Glucose	**10.8** mmol/L
Glucose Management Indicator (GMI)	**8.0% or 64 mmol/mol**
Glucose Variability	**36.8%**

Defined as percent coefficient of variation (%CV); target ≤36%

TIME IN RANGES



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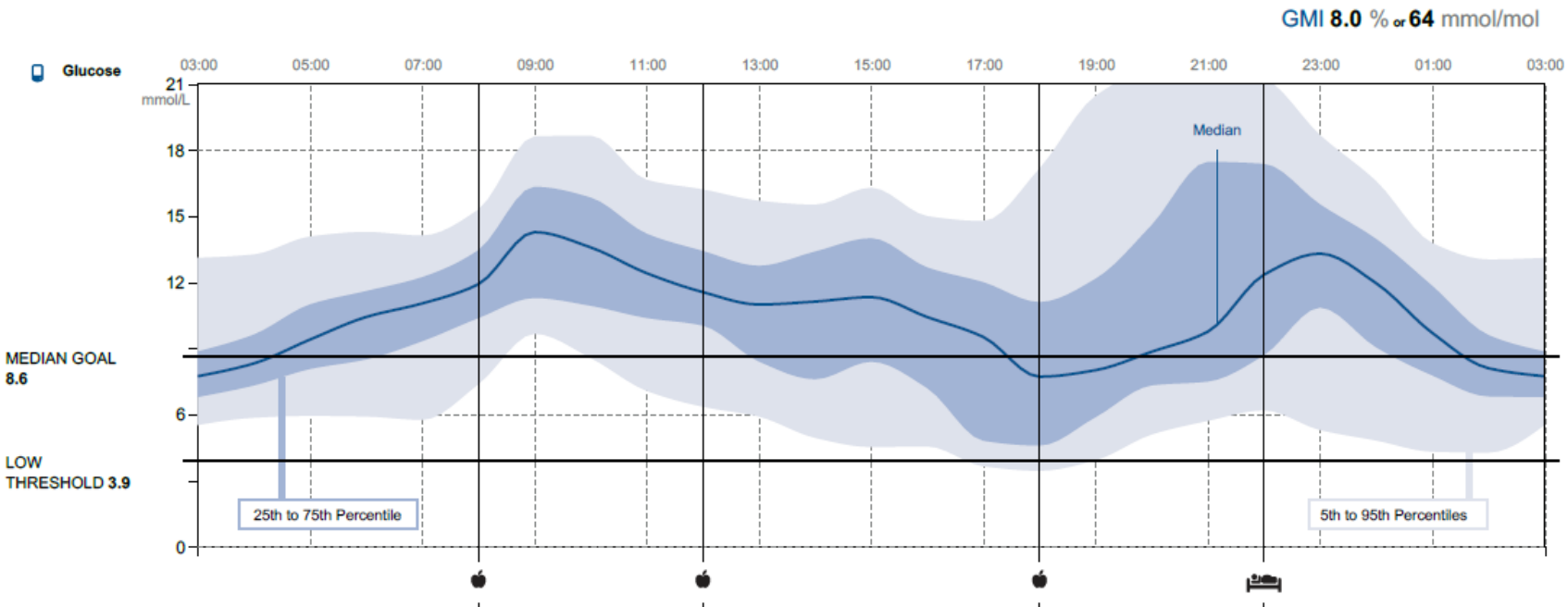
Case 1

Glucose Pattern Insights

2 March 2021 - 15 March 2021 (14 Days)

LibreView



Likelihood of **LOW GLUCOSE**		OK			
MEDIAN GLUCOSE Compared to goal					
VARIABILITY BELOW MEDIAN Median to 10th percentile					

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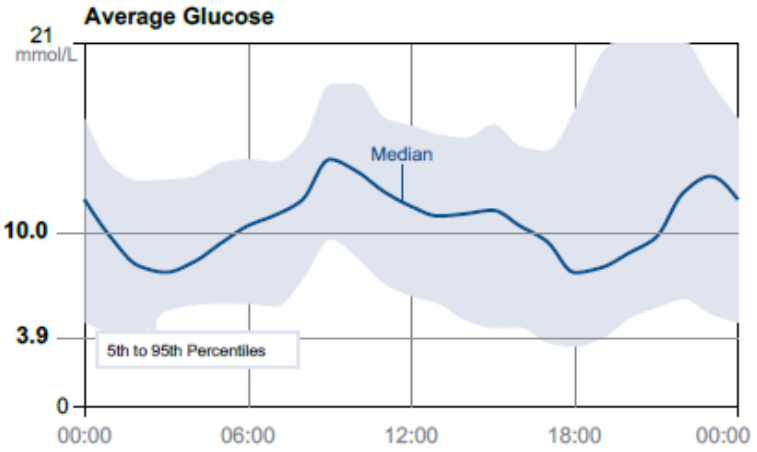
Case 1

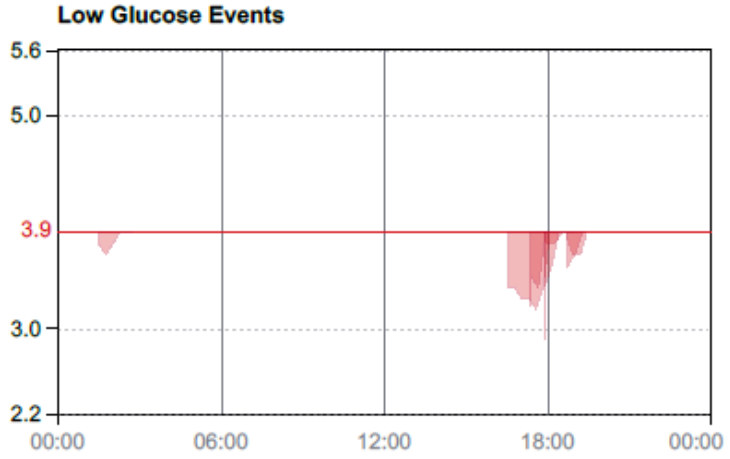
Glucose

GMI **8.0** % or **64** mmol/mol

AVERAGE GLUCOSE	**10.8**	mmol/L
% above target	**56**	%
% in target	**42**	%
% below target	**2**	%



LOW GLUCOSE EVENTS	**6**
Average duration	**69** Min



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Case 2

AGP Report

3 June 2021 - 16 June 2021 (14 Days)

LibreView

GLUCOSE STATISTICS AND TARGETS

3 June 2021 - 16 June 2021	**14 Days**
% Time Sensor is Active	**93%**

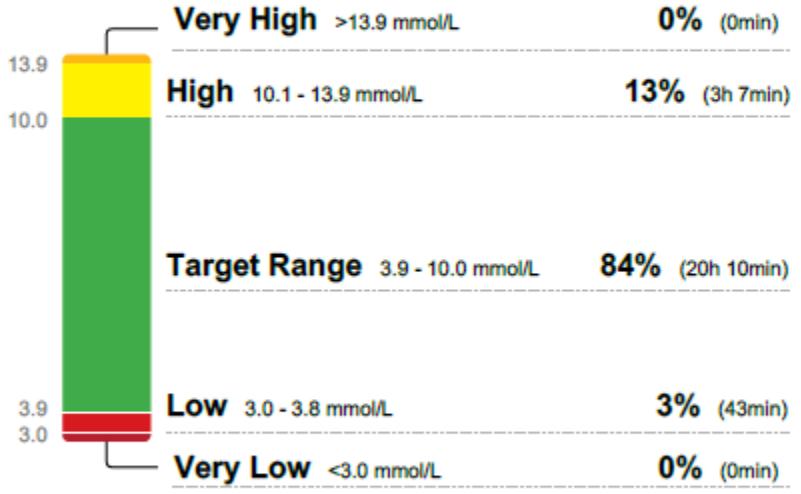
Ranges And Targets For	Type 1 or Type 2 Diabetes
Glucose Ranges Target Range 3.9-10.0 mmol/L	**Targets** % of Readings (Time/Day) Greater than 70% (16h 48min)
Below 3.9 mmol/L	Less than 4% (58min)
Below 3.0 mmol/L	Less than 1% (14min)
Above 10.0 mmol/L	Less than 25% (6h)
Above 13.9 mmol/L	Less than 5% (1h 12min)

Each 5% increase in time in range (3.9-10.0 mmol/L) is clinically beneficial.

Average Glucose	**7.5** mmol/L
Glucose Management Indicator (GMI)	**6.5% or 48 mmol/mol**
Glucose Variability	**29.3%**

Defined as percent coefficient of variation (%CV); target ≤36%

TIME IN RANGES



AMBULATORY GLUCOSE PROFILE (AGP)

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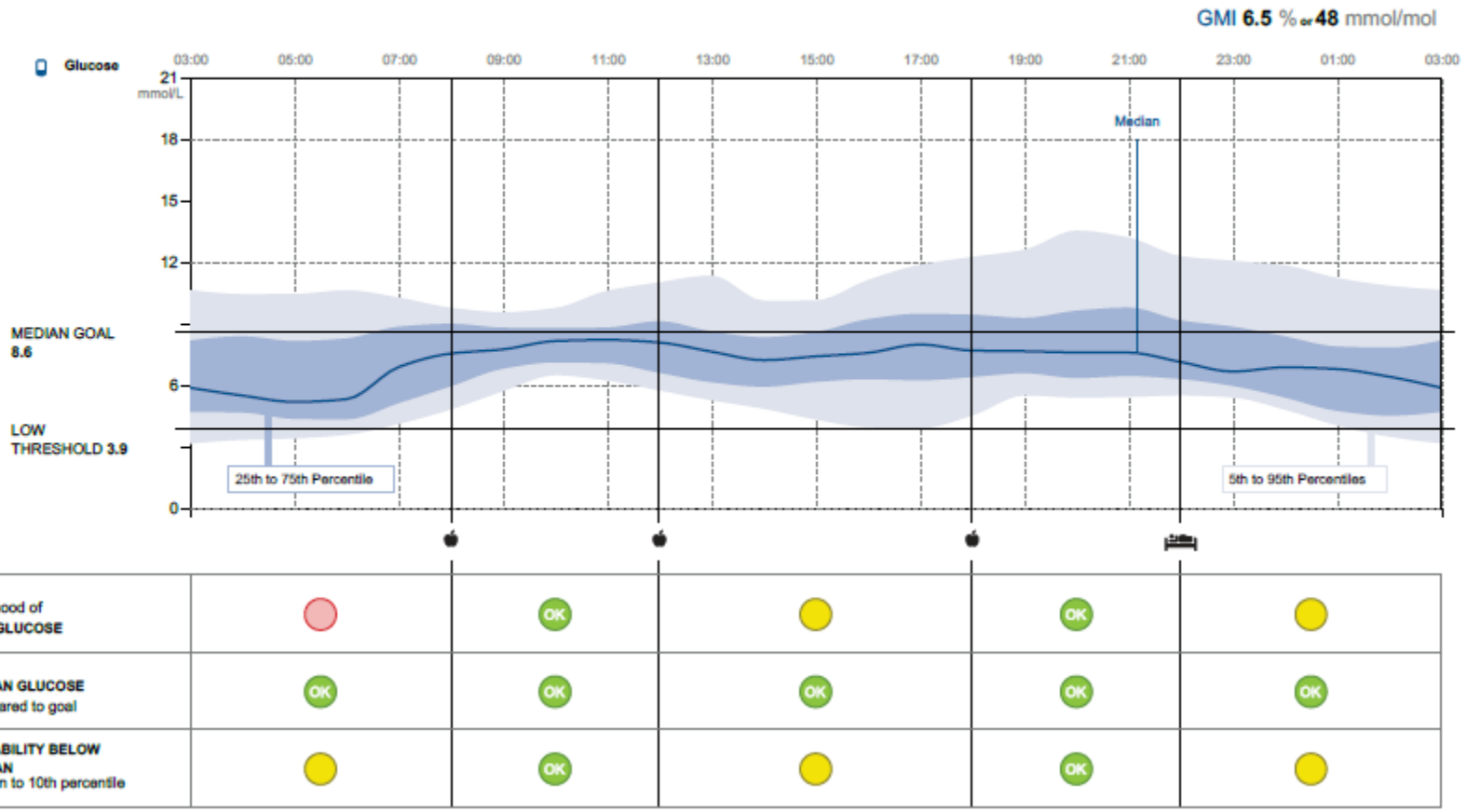
Case 2

Glucose Pattern Insights

3 June 2021 - 16 June 2021 (14 Days)

LibreView



Likelihood of **LOW GLUCOSE**		OK		OK	
MEDIAN GLUCOSE Compared to goal	OK	OK	OK	OK	OK
VARIABILITY BELOW MEDIAN Median to 10th percentile		OK		OK	

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Case 2

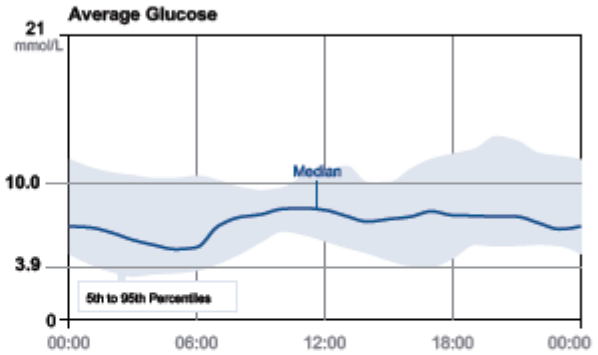
Snapshot

3 June 2021 - 16 June 2021 (14 Days)

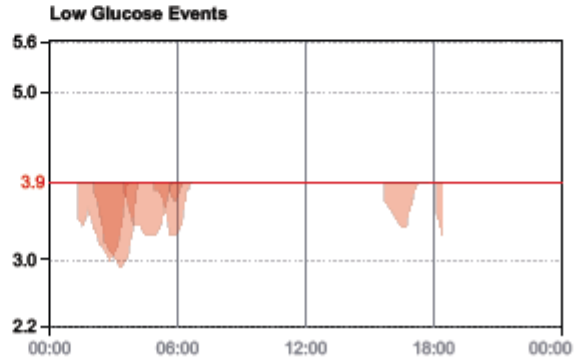
Glucose

GMI **6.5** % or **48** mmol/mol

AVERAGE GLUCOSE	**7.5** mmol/L
% above target	**13** %
% in target	**83** %
% below target	**4** %



LOW GLUCOSE EVENTS	**7**
Average duration	**123** Min



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Case 3

AGP Report

31 August 2021 - 13 September 2021 (14 Days)

LibreView

GLUCOSE STATISTICS AND TARGETS

31 August 2021 - 13 September 2021	**14 Days**
% Time Sensor is Active	**74%**

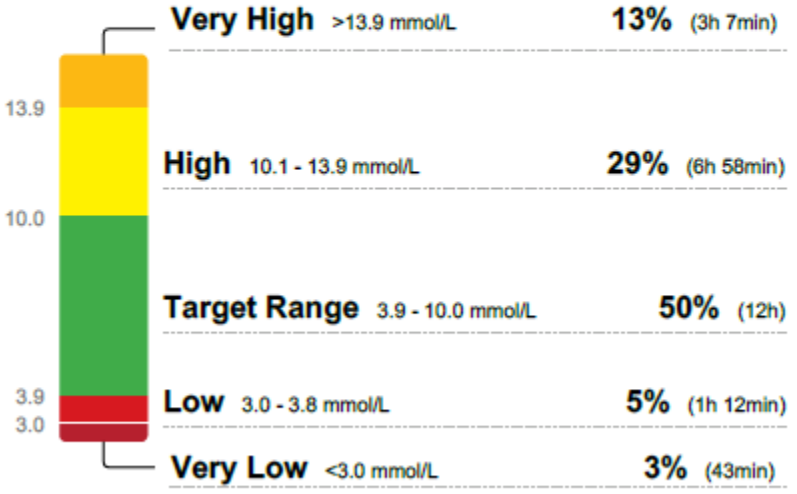
Ranges And Targets For	Type 1 or Type 2 Diabetes
Glucose Ranges Target Range 3.9-10.0 mmol/L	**Targets** % of Readings (Time/Day) Greater than 70% (16h 48min)
Below 3.9 mmol/L	Less than 4% (58min)
Below 3.0 mmol/L	Less than 1% (14min)
Above 10.0 mmol/L	Less than 25% (6h)
Above 13.9 mmol/L	Less than 5% (1h 12min)

Each 5% increase in time in range (3.9-10.0 mmol/L) is clinically beneficial.

Average Glucose	**9.4** mmol/L
Glucose Management Indicator (GMI)	**7.3% or 57 mmol/mol**
Glucose Variability	**42.3%**

Defined as percent coefficient of variation (%CV); target ≤36%

TIME IN RANGES



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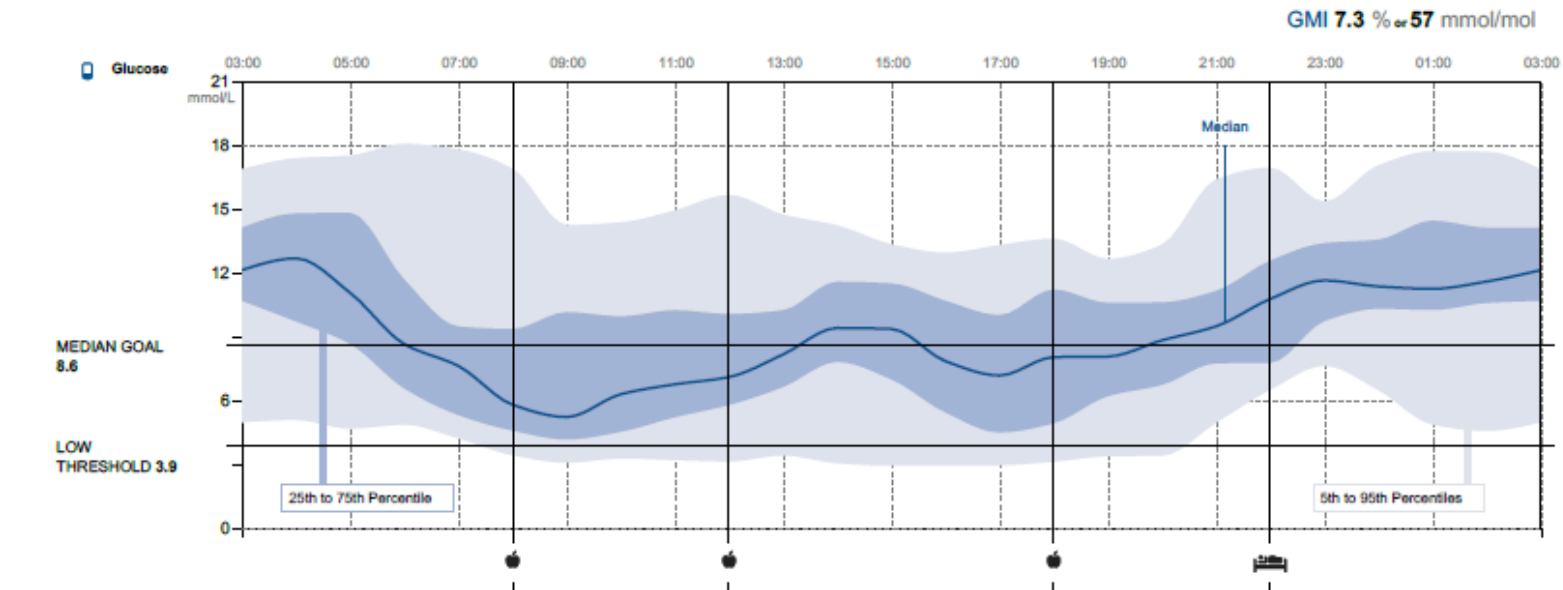
Case 3

Glucose Pattern Insights

31 August 2021 - 13 September 2021 (14 Days)

LibreView



VARIABILITY BELOW MEDIAN IS HIGH This makes it difficult to achieve the median glucose goal without increasing the likelihood of low glucose.

Factors that could contribute to variability below median:

- ☐ Erratic diet
- ☐ Incorrect or missed medication
- ☐ Alcohol consumption
- ☐ Variations in activity level
- ☐ Illness

East and North Hertfordshire NHS
NHS Trust

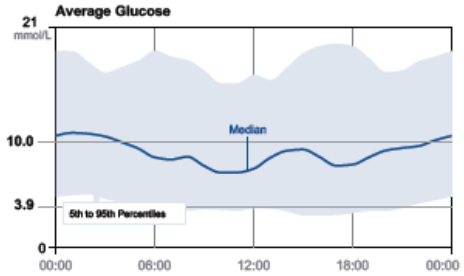
ENHIDE
East and North Herts Institute of Diabetes and Endocrinology

Case 3

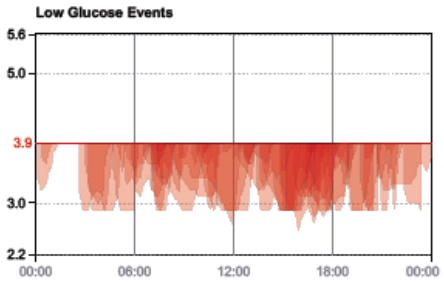
Snapshot
16 June 2021 - 13 September 2021 (90 Days)

Glucose
GMI 7.5 % or 58 mmol/mol

AVERAGE GLUCOSE	9.7 mmol/L
% above target	42 %
% in target	52 %
% below target	6 %



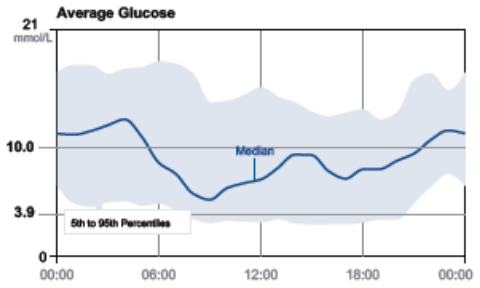
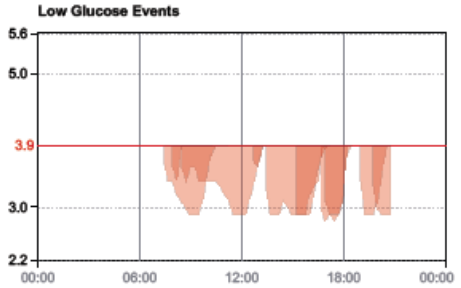
LOW GLUCOSE EVENTS	58
Average duration	115 Min



Snapshot
31 August 2021 - 13 September 2021 (14 Days)

Glucose
GMI 7.3 % or 57 mmol/mol

AVERAGE GLUCOSE	9.4 mmol/L
% above target	42 %
% in target	50 %
% below target	8 %



LOW GLUCOSE EVENTS	10
Average duration	138 Min