

Practical Approach to Management of CGM and Flash Glucose (Libre) Systems for Children and Young People with T1DM



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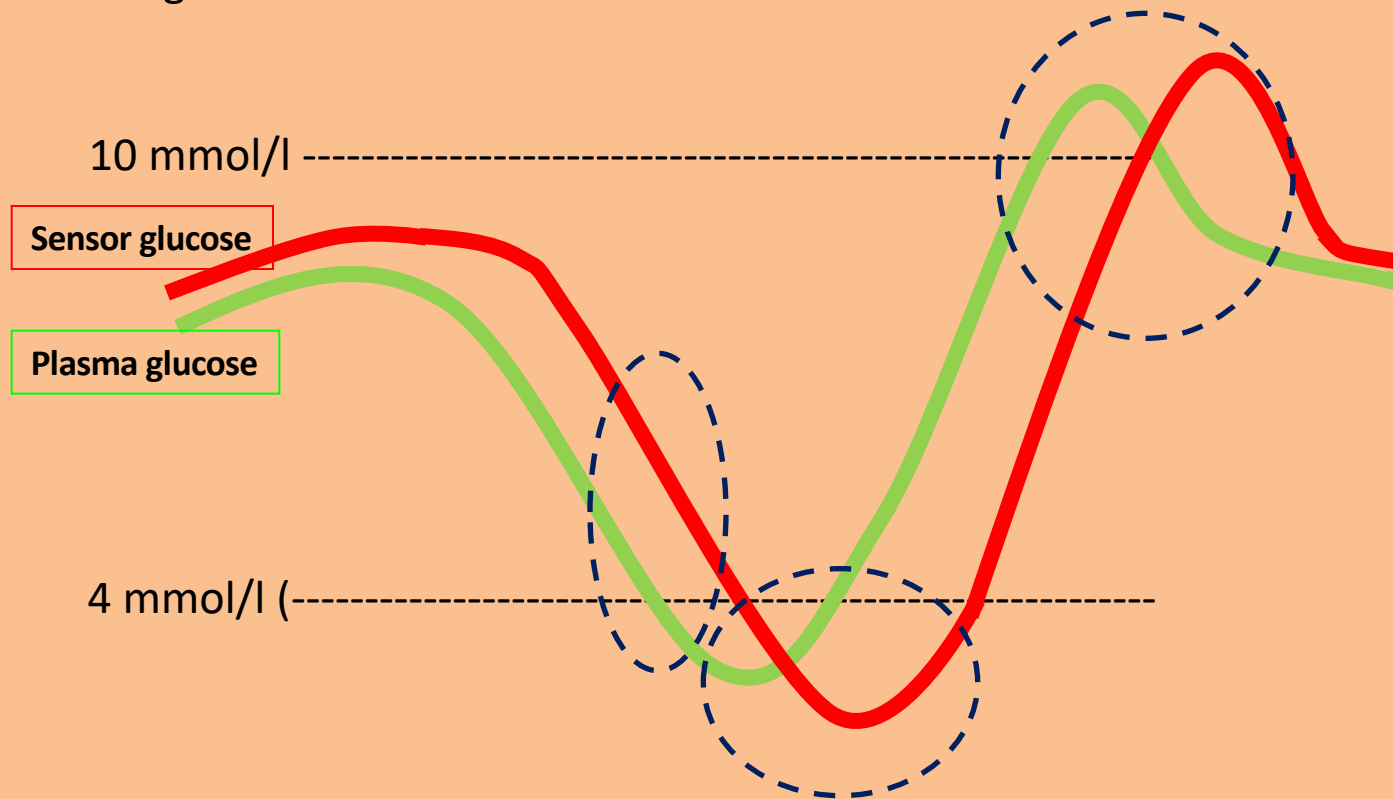
Twitter @mayng888

Outline

- **Understanding CGM and Flash Glucose Monitoring systems**
- **Ambulatory Glucose Profile – A Systematic Approach to Interpretation**
- **CGMS/ Libre Basics including Trend arrows/alerts**
- **Barriers to CGM/Libre use**

Differences in blood vs sensor glucose = lag time

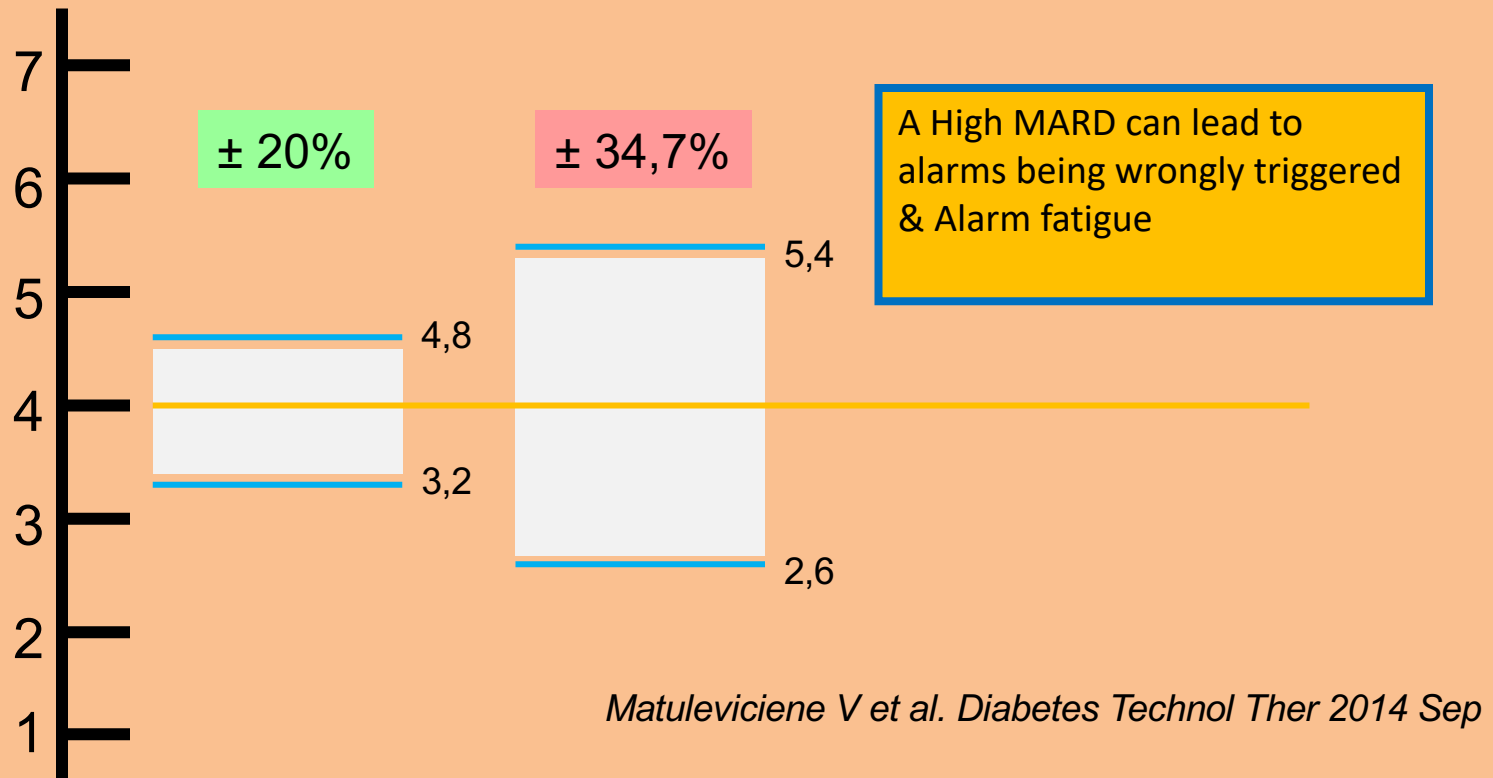
CGM/Libre systems measure glucose levels in interstitial fluid not directly in the blood. Time is needed for these two levels to achieve equilibrium especially during rapid change in blood glucose concentration levels.



Lag Time is about 5-10 minutes

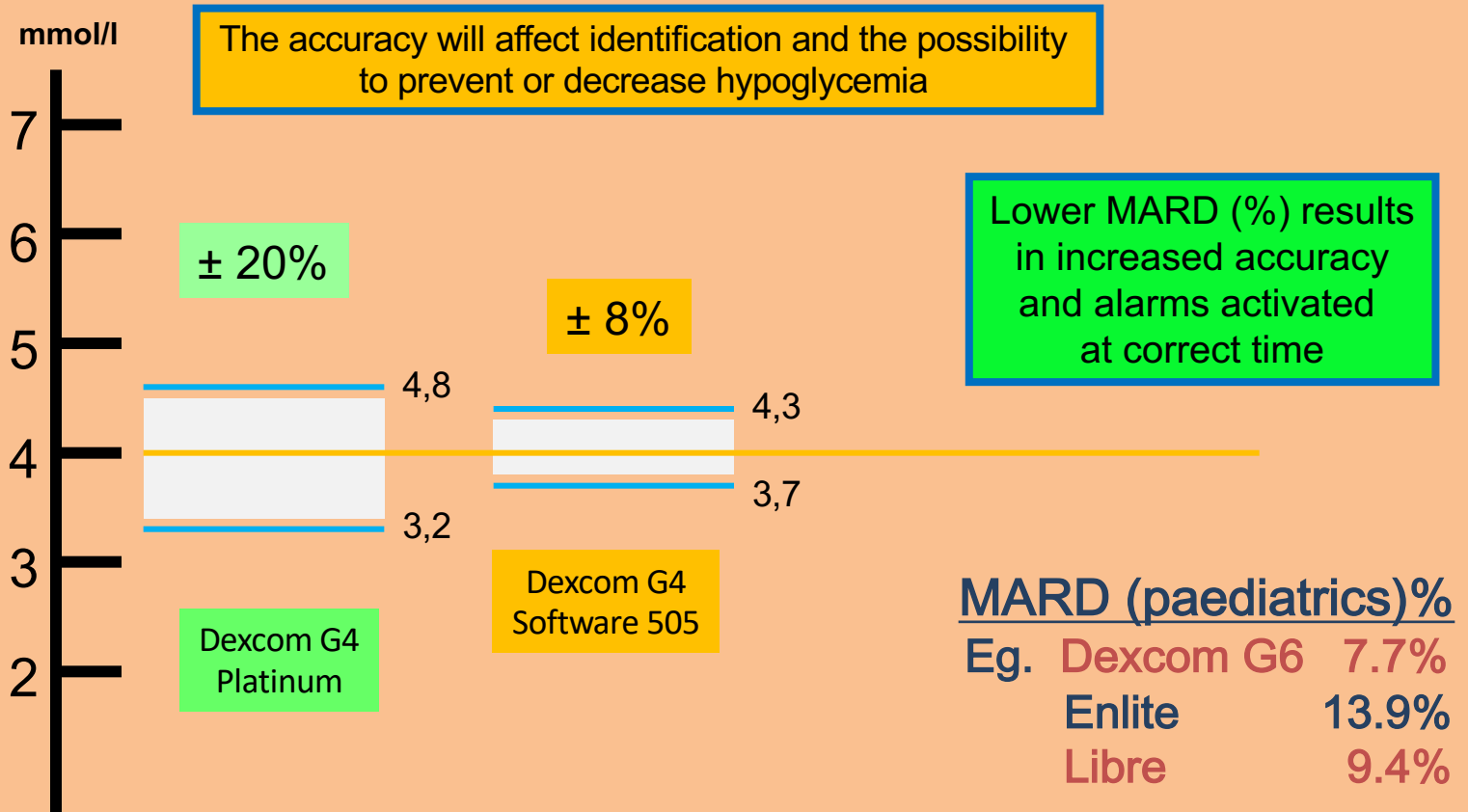
Longer time of changing sensors can result in longer the delay in lag time

CGM limitations- Mean Absolute Relative Difference



*The lower the MARD of the glucose sensor system, the more accurate the reading is to physiological blood glucose

CGM limitations- Mean Absolute Relative Difference



Diabetes Technol Ther. 2015 Aug;17(8):548-54.

Peyser TA, Nakamura K, Price D, Bohnett LC, Hirsch IB, Balo A.

Different systems have different capabilities..

	MEDTRONIC ENLITE	DEXCOM G4/G5	DEXCOM G6	FLASH GLUCOSE SENSORS - LIBRE
Mean ARD Paediatrics, all range	13.6%	15% /10%	7.7% (paeds)	13.9%
Glucose monitoring	Real time	Real time	Real time	Instant and retrospective
Glucose display	Continuous Changes every 5 mins	Continuous Changes every 5 mins	Continuous Changes every 5 mins	Continuously measures glucose every minute & stores up to 8 hours of glucose data
Calibration?	Y	Y	No	No
Alarms	Y	Y	Y	No
License (yrs)	2	2	2	4
Duration (days)	6	7	10	14
Low Glucose suspend	Y	N	Urgent low soon Alarm	N

Ambulatory Blood Glucose Profile (AGP)

Glucose

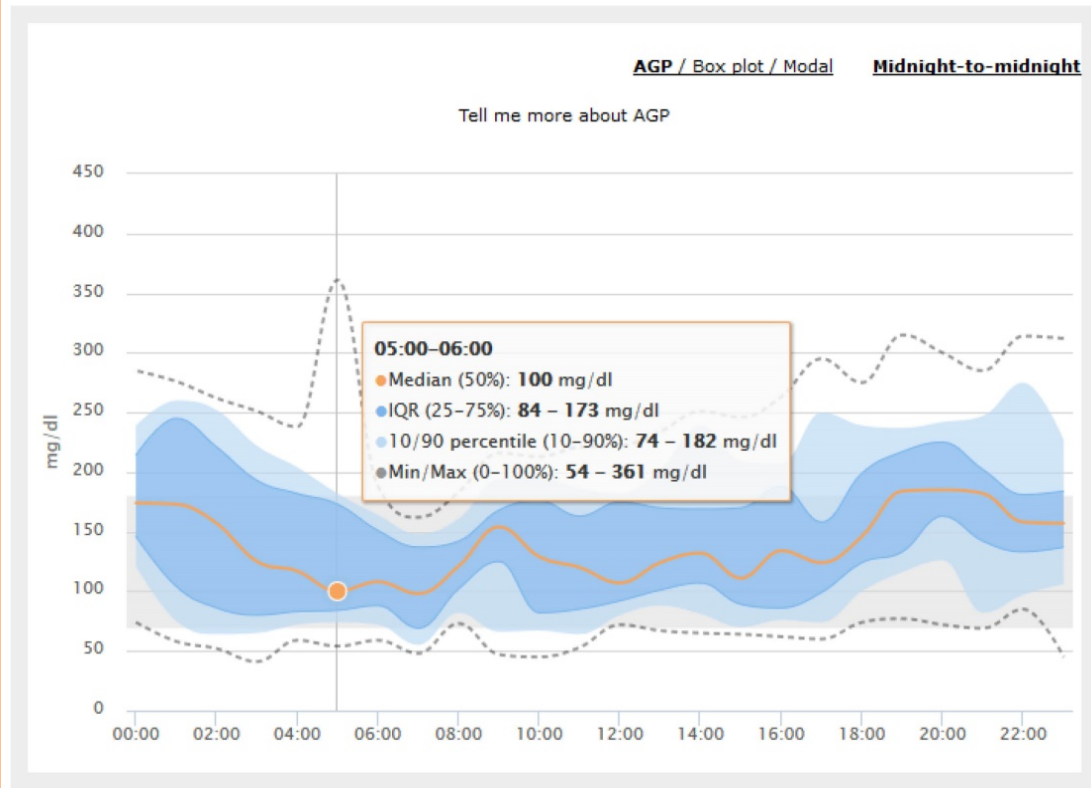
CGM

Insulin

Comparison

Compilation

Standard day



- The median line represents the middle of the value series within each hour.
- The darker blue area represents the Interquartile range (“IQR”), : the middle 50% of the values are within this range.
- The lighter blue area represents the 10th and 90th percentile,
- The maximum and minimum values are also visualized
- Glycemic variability (GV) refers to swings in blood glucose levels

Interpreting AGP

Consider quality of data

Review patients typical day routine : insulin regimen, food, physical activity

Review areas of Hypoglycaemia: where 10th centile (light blue area) dips below 4mmol/l






Review Time in range, AGP for each part of the day (Median glucose orange line) overnight, Breakfast to lunch, Lunch to evening meal, Evening meal to bedtime

Review Glycaemic Variability and understand reason for any day to day variability

Summarise key messages and action plans, discuss with your team

What trend arrows mean?

Flash Glucose monitoring system (FreeStyle Libre)

Arrow Trend	Description		
	Glucose is rising quickly (more than 0.1 mmol/L per minute)	Rise by 1 mmol/l in 10 mins	Rise by 6mmol/l in 1 hour
	Glucose is rising (between 0.06 - 0.1 mmol/L per minute)	Rise by 0.6 mmol/l in 10 mins	Rise by 3.6mmol/l in 1hr
	Glucose is changing slowly (less than 0.06/L per minute)	Stable	Stable
	Glucose is falling (between 0.06 - 0.1 mmol/L per minute)	Drop by 0.6 mmol/l in 10 minutes	Drop by 6mmol/l in 1 hr
	Glucose is falling quickly (more than 0.1 mmol/L per minute)	Drop by 1 mmol/l in 10 minutes	Drop by 6mmol/l in 1 hr

Dexcom: What do the arrows mean?



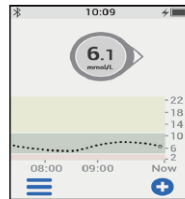
ssociation of Children's Diabetes Clinicians

Dexcom G6 Trend arrows - **STEP 1** - Patient information

What the trend arrows mean on your Dexcom G6

The trend arrow shows (circle with number):

- If the glucose is stable, rising or falling
- How fast this change is happening



Arrow Trend	Speed and direction of trend arrow
	Constant: Glucose is changing less than 0.06 mmol/L per min. or up to 0.8 mmol/L in 15 mins
	Slowly rising: Glucose is rising slowly 0.06 - 0.1 mmol/L each min. or up to 1.7 mmol/L in 15 mins
	Rising: Glucose is rising 0.1 - 0.2 mmol/L each min. or up to 2.5 mmol/L in 15 mins
	Rapidly rising: Glucose is rising more than 0.2 mmol/L each min. or more than 2.5 mmol/L in 15 mins
	Slowly falling: Glucose is falling 0.06 - 0.1 mmol/L each min. or up to 1.7 mmol/L in 15 mins
	Falling: Glucose is falling 0.1 - 0.2 mmol/L each min. or up to 2.5 mmol/L in 15 mins
	Rapidly falling: Glucose is falling more than 0.2 mmol/L each min. or more than 2.5 mmol/L in 15 mins
	No arrow: The receiver cannot work out if the glucose is going up or down and how fast



- Up arrow consider taking more insulin



- Down arrow consider taking less insulin

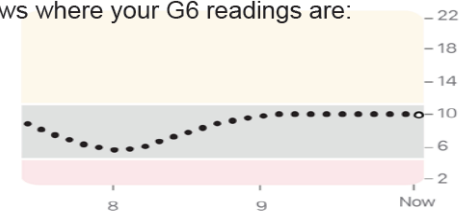
What the trend graphs mean on your Dexcom G6

The graph colour shows where your G6 readings are:

Yellow = High

Gray = InTarget

Red = Low



The trend graph is a time frame for you to look at your glucose levels in more detail. The white dot is your current G6 reading.

It can be set at 1, 6, 12 or 24 hour intervals (3 hour is always displayed when the receiver is switched on).

You can switch between these times if you need to.

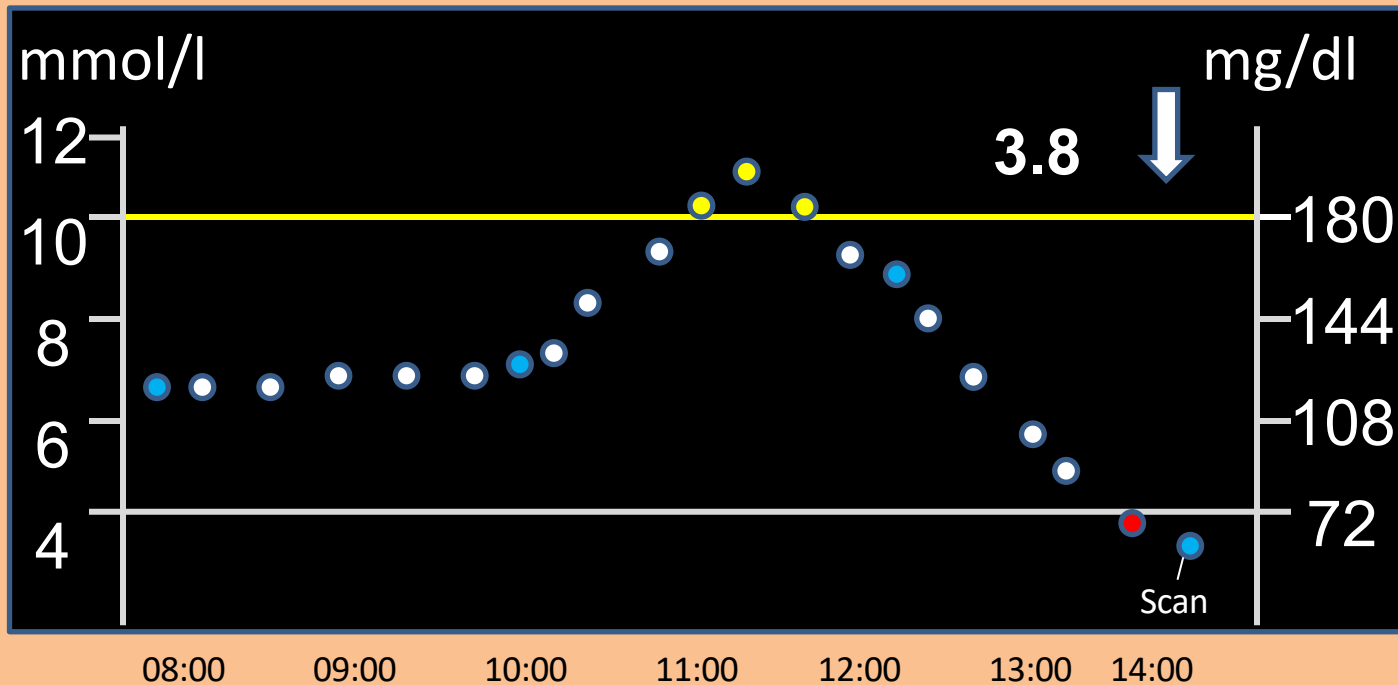
Over the next 2 weeks you will be asked to look at the different trend graphs and work out which one you prefer.

Think about why you want to use the CGM and which method of looking at your glucose levels is better for you.

But do not use the glucose results for altering your insulin dose until you have completed **STEP 2** and **3**.

Libre– what is your advice?






Scanning recommended prior to the meal and 2 hours after



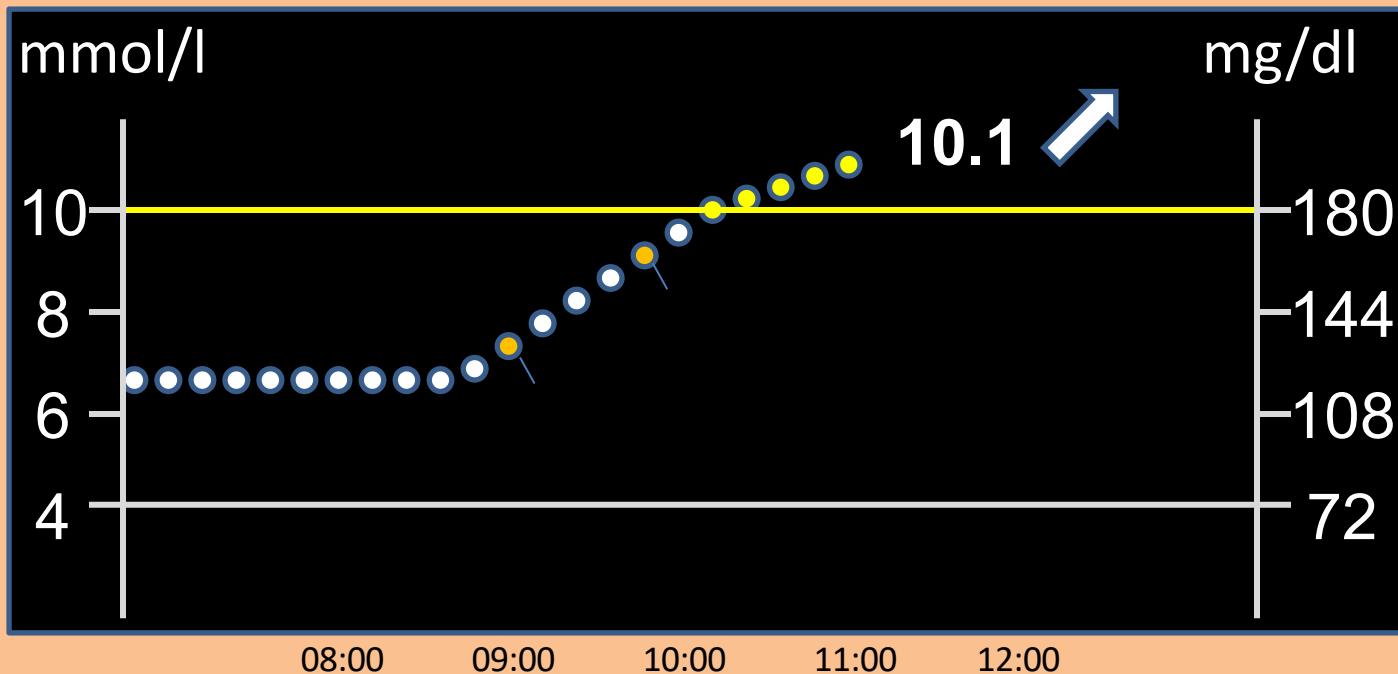
John had a snack at 10.00am and bolused his insulin dose prior to this. The next meal is planned for at 14.00 –His Libre shows this at 13.55 What should he do next?

Using Trend Arrows and Percentage Tool to aid in correcting rising BGs or preventing hypos

E.g. Freestyle Libre

Arrow Trend	Description	Action
	Glucose is rising quickly (more than 0.1 mmol/L per minute)	Add 20% of meal time dose as extra
	Glucose is rising (between 0.06 - 0.1 mmol/L per minute)	Add 10% of meal time dose as extra
	Glucose is changing slowly (less than 0.06/L per minute)	No Change
	Glucose is falling (between 0.06 - 0.1 mmol/L per minute)	Deduct 10% of meal time dose as extra
	Glucose is falling quickly (more than 0.1 mmol/L per minute)	Deduct 20% of meal time dose as extra

CGM- What is your advice?



Lucy had breakfast at 10.00am and dosing was prior to the meal.
What should she do next?

Using Trend Arrows and Percentage Tool to aid in correcting rising BGs or preventing hypos

Method 1 - Total insulin dose percentage adjustment

This table helps you to decide how much insulin to give by using the glucose level and the direction of the trend arrow before a meal and when a blood glucose must also be taken before deciding on your dose.

Arrow Trend	Description of trend arrow	Action needed
→	Stable: It may go up or down by 0.8 mmol/L in 15 mins	Give dose as calculated
↗	Slowly rising: It may go up by 1.7 mmol/L in 15 mins	Add 10% extra to calculated dose
↑	Rising: It could go up by 2.5 mmol/L in 15 mins	Add 20% extra to calculated dose
↑↑	Rising rapidly: It may go up more than 2.5 mmol/L in 15 mins	Add 20-30% extra to calculated dose If glucose >8 mmol/L consider 25-30% but if <8mmol/L consider 20%
↘	Slowly falling: It may go down by 1.7 mmol/L in 15 mins	Take away 10% from calculated dose
↓	Falling rapidly: It could fall by 2.5 mmol/L in 15 mins	Take away 20% from calculated dose
↓↓	Falling very rapidly: It may go down by more than 2.5 mmol/L	Take away 20 - 30% from calculated dose
Blank No arrow	If no trend arrow appears: The receiver cannot work out if the glucose is going up or down and how fast	

Dexcom

How to work out 10% of your meal time dose:

10% of meal time insulin = meal time insulin ÷ 10

This amount will either be added to your meal time dose or take off your meal time dose

How to work out 20% of your meal time dose:

20% of meal time insulin = meal time insulin ÷ 5

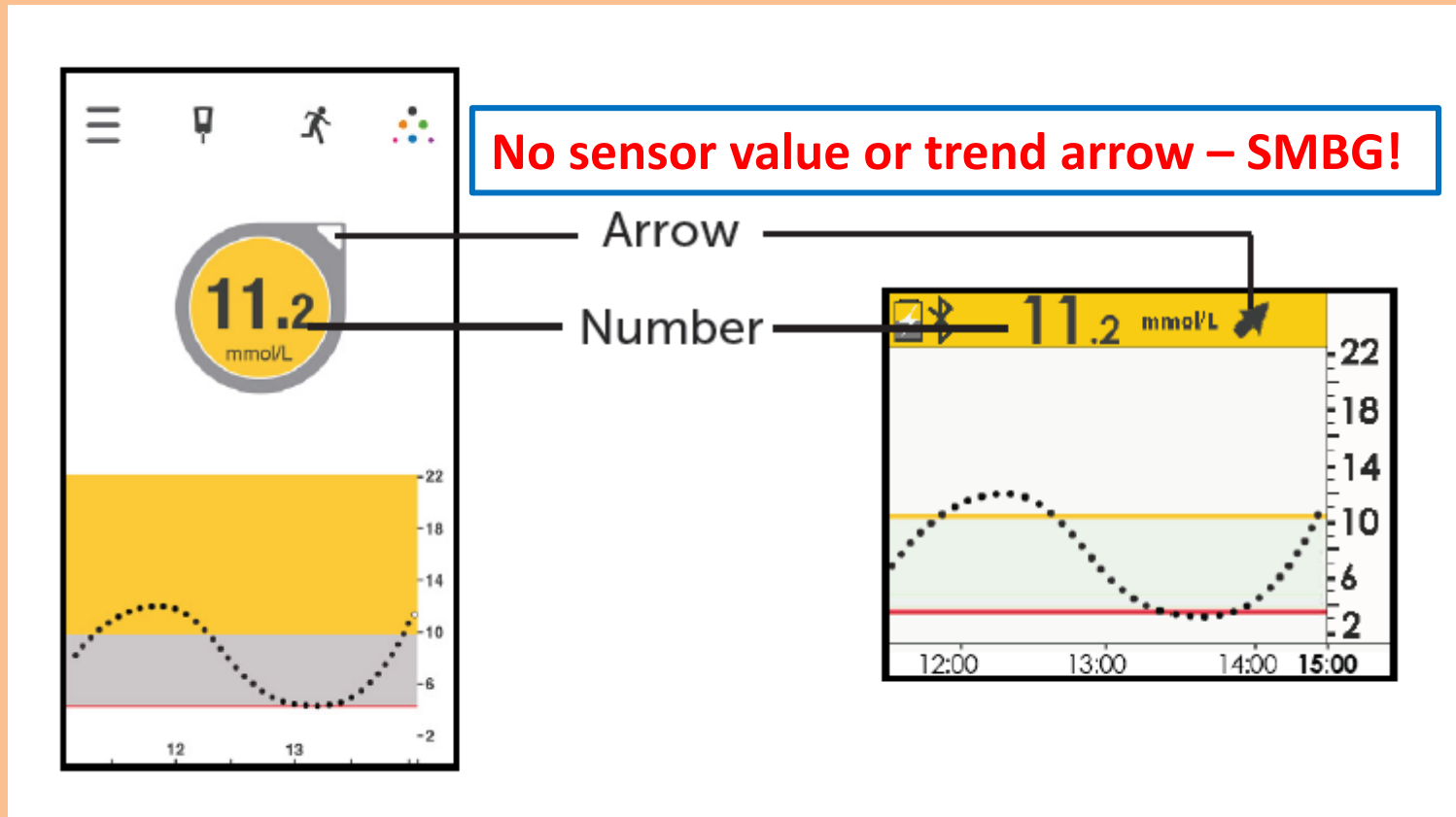
This amount will either be added to your meal time dose or taken off your meal time dose

How to work out 30% of your meal time dose:

30% of meal time insulin = meal time insulin ÷ 100 x 30

This amount will either be added to your meal time dose or taken off your meal time dose

Making CGM Based Treatment Decisions – Need a Sensor Number and a Trend Arrow









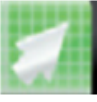
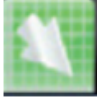


If CGM readings do not match your clinical symptoms – a SMBG (finger prick) value should be obtained before making a treatment decision

Trend arrows: A Summary

Medtronic	Dexcom	Libre	Change in glucose (mmol/l) in 15 mins	Description
	→	→	0 - 0.8	Stable
↓	↘	↘	0.8 – 1.7	Falling slowly
↓↓	↓	↓	1.7 – 2.5	Falling quickly
↓↓↓	↓↓		> 2.5	Falling rapidly
↑	↗	↗	0.8 – 1.7	Rising slowly
↑↑	↑	↑	1.7 – 2.5	Rising quickly
↑↑↑	↑↑		> 2.5	Rising rapidly

Do you know your different Alarms?

	Vibration 	Soft 	Normal 	Hyporepeat 	attentive 
High glucose alert					
	2 long vibrations	2 long vibrates +2 low beeps	2 long vibrates +2 medium beeps	2 long vibrates +2 medium beeps	2 long vibrates + ascending melody
Low glucose alert					
	3 short vibrations	3 short vibrates +3 low beeps	3 short vibrates +3 medium beeps	3 short vibrates +3 medium beeps	3 short vibrates + descending melody
Urgent low alarm - ** preset safety alarm to prevent hypos. If selected repeated every 5 mins					
	4 short vibrations	4 short vibrates +4 medium beeps	4 short vibrates +4 medium beeps	4 short vibrates + 4 long beeps + pause + repeat sequence **	4 short vibrates + 2 long descending melodies + pause + 4 low beeps
Rising glucose					
	2 long vibrations	2 long vibrates +2 low beeps	2 long vibrates +2 medium beeps	2 long vibrates +2 medium beeps	2 long vibrates + 1 Short ascending melody
Falling glucose					
	3 short vibrations	3 short vibrates +3 low beeps	3 short vibrates +3 medium beeps	3 short vibrates +3 medium beeps	3 short vibrates + 2 Short descending melody

Alert vibrations and sounds



All alerts and alarm will start with a vibration



An alert sounds every 5 mins



The receiver will continue to give a warning every 5 mins until you confirm by pressing the SELECT button or until the glucose reading has fallen below the high alert or risen above low alert settings



The different alerts have their own number of vibrations beeps so you can hear the difference. See red numbers on the table opposite



If you worry about hypos during the night you can use the Hyporepeat Profile. The 3.1 alarm will repeat every 5 seconds



Remember!

Learning the different sound alerts enables you to recognise important messages when unable to look at the receiver i.e. 4 vibration/beeps means take immediate action

Setting Alarms

Depends on individual targets:

- For prevention of hypos, set at a higher level e.g 4.5-5mmol/l to enable warnings
- If the problem is high HbA1c, then set alarm at high BG and gradually reduce as glycaemia improves (individualise accordingly)
- If the issue is forgotten boluses ,then set hyperglycaemia alarm lower so warns the PWD early

Do not be ambitious – beware of alarm fatigue

**especially when first starting to use a glucose sensor system

Advice about using CGMS/Libre

- Be familiar with the database/downloads you are using
- Download regularly!
- Review BG/Scan (Libre) before and 2 hours after meals
- Review impact of illness, exercise , different foods
- Review BG /Scan within 10 minutes if trend arrow is pointing up or down
- Crosscheck with a BG if
 - **Hypoglycaemia**
 - **If symptoms don't match the glucose level**
 - **If glucose is changing rapidly (arrows)**

ACDC 4 STEP EDUCATION PROGRAMME

- **STEP 1:**
Getting started with CGM system
Understanding the basic knowledge of your CGM system
Learn to identify trends and patterns
- **STEP 2:**
Setting alerts for high and low glucose readings
HbA1c and targets
Setting glucose alerts
Use trend arrows to set advanced alerts
- **STEP 3:**
Optimise the effect of CGM using trend arrows
How to use the total dose percentage adjustment tool
How to use the insulin sensitivity factor tool (ISF)
Trend arrows and low glucose levels
- **STEP 4:**
How to use the Ambulatory Glucose Profile (AGP)



Objectives

- CGM/Libre is primarily an aid
- For best results needs to be done regularly (eg wear it at least 70% of the time)
- Look at overview downloads but don't make changes until you have reviewed day to day data
- Address the low sugars, be a detective and find out why
- Review overnight data
- Look at the high sugars, be a detective and find out why

4 STEP EDUCATION PROGRAMME

Freely available CGM/Libre leaflets produced

- Dexcom G5
- Dexcom G4
- Freestyle Libre
- Medtronic



www.a-c-d-c.org

Executive Summary

Clinical Guideline

A Practical Approach to the Management of Continuous Glucose Monitoring (CGM) / Real-Time Flash Glucose Scanning (FGS) in Type 1 Diabetes Mellitus in Children and Young People Under 18 years

This is an executive summary of the main guideline intended for use in managing continuous glucose monitoring (CGM) or real-time flash glucose scanning (FGS) for children and young people under 18 years with Type 1 diabetes mellitus.

Introduction

Real-time continuous glucose monitoring (CGM) and flash glucose scanning (FGS) are new and evolving technologies in the management of type 1 diabetes. In addition CGM can be linked to insulin pump therapy providing sensor augmented pump technology (SAPT). In order to ensure that healthcare professionals, families and children are appropriately informed and educated on these technologies, the Association of Children's Diabetes Clinicians (ACDC) has developed a comprehensive guideline following extensive reviews of the literature and consultation to help identify which patients may be most likely to benefit and how these technologies may be practically implemented.

The National Institute of Clinical Excellence (NICE) has produced two guidelines relevant to the use of CGM. Guideline NG18 on management of children and young people with type 1 and type 2 diabetes and diagnostics guidance DG21 regarding the use of SAPT. A Medtech Innovation Briefing (MIB) 51 regarding the Minimed™ 640G has also been published.

The main guideline has 2 key sections:

- Section 1** A review of the evidence to support the use of CGM and FGS and recommendations regarding patient selection, criteria for regular use, criteria for diagnostic use and circumstances where technology should be withdrawn.
- Section 2** A Practical Guide for Healthcare Professionals - Implementation of the Technology and a Toolkit of Resources to Support Professionals Facilitating Patient Self-Management. All material is freely available on the ACDC website www.a-c-d-c.org

ACDC have produced Main Guideline, Executive Summary and specific leaflets on

‘Continuous Glucose Monitoring (CGM) and Flash Glucose (Libre) systems Training for Healthcare Professionals and Patients’.

These can be freely downloaded from the ACDC website

Go to www.a-c-d-c.org.

Click on **Clinical**

Click on **Endorsed guidelines**

Download the guideline pdf

Thank you from

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