Association of Hong Kong Diabetes Nurses
Evidence-based Practice Project



Continuous Glucose Monitoring System:
Practice Guide for Diabetes Nurse 2nd Version

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Preface

One important goal in management of diabetes mellitus (DM) is prevention of the development of chronic diabetic complications, which arise as a result of long-standing poor glycemic control. Availability of continuous glucose monitoring (CGM), first introduced in 1999, is transforming the way diabetes is managed, especially in patients with type 1 or poorly controlled diabetes.

CGM technology allows for continuous recording of glucose readings and acquisition of daily profile without the discomfort associated with frequent finger pricking, the continual data thus generated can help patients and health care professionals to make informed and timely treatment decisions. CGM has been shown to lower A1C, reduce glucose excursion, and minimize hypoglycemic frequencies, and is particularly useful in management of insulin-treated patients especially those on complex treatment regimen and/or with hypoglycemia unawareness. With advancement of CGM technology, CGM derived metrics such as time in range and coefficient of variation have also found application as valid parameters for day-to-day DM management, with potential relevance in clinical research and incorporation into the standards of clinical practice guidelines.

When applied appropriately, modern diabetes technology like CGM can improve the lives and health of people with diabetes. On the other hand, the complexity and rapidly changing technology landscape can be a deterrent to patient and provider implementation. Appropriate educational and technical support for both people with diabetes and health care providers are thus needed to solidify the emerging status of continuous glucose data as a standard of care for daily DM management quality.

As CGM systems become more affordable and accessible to patients with diabetes, it is timely for our AHKDN educators to appraise the literature and revise this guidebook to disseminate the knowledge and techniques of this novel monitoring modality. Their tremendous efforts in extensively reviewing the literature and elegantly enhancing this guidebook to promote the best evidence-based practice are commendable. Given continuous advancement in the field, we could envisage future update of this guidebook for application of the innovations to advance diabetes management and benefitting the ever increasing population of people with diabetes in Hong Kong.

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Highlight of Major Changes

In parallel with the rapid technology advancement and increased clinical experience of continuous glucose monitoring system (CGMS) in recent years, our group members have updated the evidence in the following areas.

1. Mode of CGMS

   Retrospective CGMS (ipro 2) faded out in 2021 and there was no other retrospective CGMS in Hong Kong Market. Therefore, all information of retrospective CGMS was deleted in the 2nd version.

2. Expansion of indications of CGMS

   During the literature review, more evidence has accumulated showing increased benefits of using CGMS in Type 1 and Type 2 diabetes. There is also extension to special populations of diabetes including gestational diabetes, renal replacement therapy group and older adults with diabetes.

3. New models of CGMS

   The updated education material facilitates CGMS education program with launching of new models of CGMS in Hong Kong. Our group will continue to update the related education material periodically.

4. Standardized Ambulatory Glucose Profile (AGP) Report

   AGP reports are standardized in all CGM providers, these reports could facilitate the interpretation of results in the same format with messages to health care professionals and patients. Therefore, our group members have updated the standard reports and simplified the documentation.

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Chapter 1: Background

The cornerstone of diabetes management is to prevent diabetes complications by achieving optimal glycemic control with minimal hypoglycemic events. Continuous glucose monitoring (CGM) has been rapidly developed and used with increasing popularity in recent years. Application of this valuable tool can facilitate people with diabetes and health care professionals to reach this desirable goal. Furthermore, individuals with diabetes will not have to perform blood glucose testing with blood glucose analyzers too frequently. CGM data thus provide actionable information for better self-diabetes management with much reduced discomfort associated with frequent finger pricking.

Given the new technology and different models of CGM, diabetes nurses have an urge to acquire the modern knowledge and skills to keep abreast with the rapid advancement and growing popularity of this innovative technology for diabetes monitoring. A workgroup under AHKDN was therefore set up to study the issue. After detailed discussion, a consensus was made to review the effectiveness of CGM in the management of diabetes through literature search, spanning the period from 2008 to 2021 with Google Scholar, PubMed, and UpToDate.

By using the PICO method, an Evidence Based Practice (EBP) purpose was set:
The purpose of the review was to summarize the best available evidence regarding the effect of a nurse-led education program on glycemic control, diabetic self-management and other health related outcomes among patients undergoing CGM for diabetic mellitus.

Participants

Diabetic patients on CGM

Intervention:

Nurse-led patient educational program for CGM user

Outcome:

Enhancement of patient outcomes in terms of stable glycemic control with less hypoglycaemia and hyperglycemia, and other health related outcomes.

We used the Johns Hopkins Nursing Evidence-Based Practice (JHKEBP) Appraisal Tool [1]
(see Appendix 1) to evaluate the evidence and state the evidence level in the findings.
The tool is to appraise research at 5 levels as follows:

Level I: Randomized Control Trial (RCT)

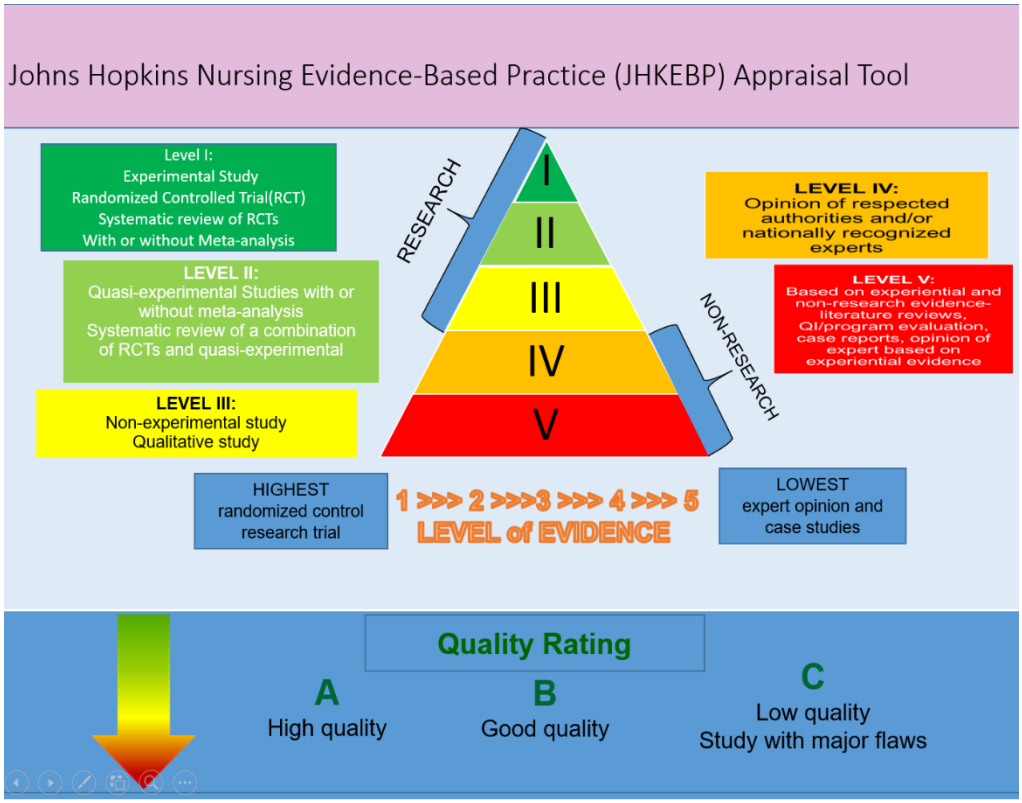
Level II: Quasi-Experimental

Level III: Non-Experimental or Qualitative

Non-research: Level IV: Clinical Practice Guidelines / Consensus or Position statement
Level V: Literature review / Expert Opinion and others

The quality of research is based on quality rating as
A: High quality **B:** Good quality **C:** Low quality or major flaws

Appendix 1



The project aimed to guide diabetes nurses:

1.1 to recognize different brands and features of CGMS

1.2 to provide quality care management to individual patients on CGM

Reference:

1. Dang,D. & Dearholt, S. (2017). Johns Hopkins Nursing Evidence-based Practice: model and guidelines. 3rd ed. Indianapolis, IN: Sigma Theta Tau International.

Chapter 2: Indication

Real-time Continuous Glucose Monitoring (rtCGM)	Evidence
rtCGM supplements the missing information from HbA1c and self-blood glucose monitoring. It shows the glucose concentration in the body's interstitial fluid near real time and provides glucose trend in previous few hours, and rate of change (trend) arrow of glucose and glucose direction. Some devices with programmable alerts/alarms provide additional safety advantage. Moreover, rtCGM facilitate monitoring of time in range and the intra and inter-day glycemic excursions.[1] There are different levels of evidence to show the effectiveness and efficiency of rtCGM in diabetes management among different groups of subjects.	Level IVA

1.	**Type 1 DM in adults who apply rtCGM on nearly daily basis**	
	1.1 Facilitate the achievement of HbA1c level to target[1-10]	Level IA
	1.2 Expedite the improvement of HbA1c level up to 12 months[2,4,8,11]	Level IA
	1.3 Reduce hypoglycemia exposure[3,12-15]	Level IB
	1.4 Improve Quality of Life due to reduced fear of hypoglycemia and elimination of the requirement for fingerstick testing[16]	Level IA
	1.5 Improve HbA1c[17]	Level IIA
2.	**Type 1 DM in children and adolescents**	
	2.1 Facilitate the achievement of HbA1c level to target [1-5,8,18,19]	Level IA
	2.2 Reduce hypoglycemia exposure[4,14]	Level IC
	2.3 Detect abnormal patterns of glycemia[2]	Level IIA
	2.4 Benefits to those subjects with or without any comorbidities who have undertaken high levels of physical activity or treatments that can make blood glucose control difficult[8,20]	Level VA
	2.5 Detect any symptomatic or asymptomatic hypoglycemia by the rtCGM with alarm function for those subjects with history of frequent severe hypoglycemia[8,20], impaired awareness of hypoglycemia associated with adverse consequences (e.g. seizures or anxiety) [8,20] and inability to recognize or communicate about symptoms of hypoglycemia (e.g. cognitive or neurological disabilities)[8,20]	Level VA
	2.6 Caution: There is no conclusion yet for or against the use of rtCGM in children with T1DM who are under 8 years old[5]	Level IA

3. **Type 1 DM in neonates, infants, and pre-school children**

3.1 Caution: Use of CGM in neonates appears safe, feasible and has been associated with better glycemic status, but there is no conclusive evidence yet of improved clinical outcomes[21] — Level VA

4. **Type 1 DM in adults using CSII and requiring frequent self-adjustment of insulin dose**

4.1 Decrease HbA1c levels and time spent in hypoglycemia[2,22,23] — Level IA

5. **Type 2 DM in adults**

5.1 Type 2 DM on MDI[12], mixed therapies [24,25], and basal insulin [26,27] have consistently shown reductions in A1C [17, 28] — Level IA & Level IB

5.2 Reduction in hypoglycaemia [13,17] — Level IA

5.3 Flash glucose monitoring helps achieve better glycemic control than conventional self-monitoring of blood glucose in non-insulin-treated Type 2 diabetes[29]. — Level 1A / Level 1A

5.4 Improvement in Diabetes Treatment Satisfaction in Type 2 diabetes[13,30]

6. **DM in older adults:**

6.1 Type 1 Diabetes in older adults (> 60 years old) Improvement in hypoglycaemia over 6 months[31]. — **Level IA**

6.2 Type 2 Diabetes in older adults (> 65 years old) who reside in nursing homes Effective way to detect and avoid hypoglycaemia in this frail population[32]. — **Level IA**

Type 2 DM in adults during haemodialysis treatment

7. 7.1 The progressive increase in MARD over days of haemodialysis which affected the accuracy of the system[33]. — **Level IIB**

7.2 Due to the uncertainty of HbA1c in diabetic kidney disease (DKD) patients, continuous glucose monitoring is an suggested alternative to monitor blood glucose control in DKD patients having dialysis, while CGM has direct measurement of interstitial glucose and is not biased by DKD or its treatments including dialysis[34]. — Level IVA

8. Pregnant women on insulin therapy

8.1 Benefit those who develop severe hypoglycemia[35] (with or without impaired awareness of hypoglycemia) and / or have unstable blood glucose levels[35]. Level VA

8.2 Use as an adjunct to pre-and postprandial blood glucose, CGM can help to achieve AIC targets in diabetes and pregnancy[36] Level IVB

8.3 Type 1 DM on MDI or CSII who are pregnant and using rtCGM in addition to standard care show improvement in A1C without an increase in hypoglycemia; including optimization of pre- and postprandial glucose targets as well as reductions in large-for-gestational-age births, length of stay, and neonatal hypoglycemia[37] Level IA

9. **Gestational Diabetes (GDM)**

9.1 Provide a more comprehensive assessment of nocturnal hyperglycemia than SMBG and improve targeting of interventions in GDM[38]. Level IIB

9.2 Lower average blood glucose levels, lower maternal weight gain and infant birth weight than women using SMBG[39]. Level IA

References:

1. Danne T, Nimri R, & et al (2017). International Consensus on Use of Continuous Glucose Monitoring, Diabetes Care, 40, 1631-1640.
2. Beck RW, Buckingham B, Miller K, & et al (2009). Factors predictive of use and of benefit from continuous glucose monitoring in type 1 diabetes. Diabetes Care, 32: 1947 – 1953.
3. Bolinder J & Antuna R, & et al (2018). Impact of flash glucose monitoring on hypoglycaemia in adults with type 1 diabetes managed with multiple daily injection therapy: a pre-specified subgroup analysis of the IMPACT randomised controlled trial, Diabetologia, 61:539–550.
4. Health Technology Assessment Program (HTA) (2017) Continuous glucose monitoring – update. Washington State Health Care Authority.
5. Klonoff DC, Buckingham B, Christiansen JS, & et al. (2011). Continuous glucose monitoring: an Endocrine society clinical practice guideline, The Journal of clinical endocrinology and metabolism 96: 2968-2979.
6. Lind M, Polonsky W, & et al (2016). Design and Methods of a Randomized Trial of Continuous Glucose Monitoring in Persons With Type 1 Diabetes With Impaired Glycemic Control Treated With Multiple Daily Insulin Injections (GOLD Study)**.** Journal of Diabetes Science and Technology, 10(3): 754–761.
7. Peters AL, Ahmann AJ, Battelino T, & et al (2016). Diabetes Technology-continuous subcutaneous insulin infusion therapy and continuous glucose monitoring in adults: an

Endocrine Society Clinical practice guideline, The Journal of clinical endocrinology and metabolism, 101: 3922-3937.

8. Riveline JP, Schaepelynck P, & et al (2012). Assessment of Patient-Led or Physician-Driven Continuous Glucose Monitoring in Patients with Poorly Controlled Type1 Diabetes Using Basal-Bolus Insulin Regimens. Diabetes Care, 35(5): 965-971.
9. Tamborlane WV, Beck RW, Bode BW, & et al. (2008). Continuous glucose monitoring and intensive treatment of Type 1 diabetes. The New England Journal of Medicine, 359: 1464-1476.
10. Twigg SM, Kazemi MR & Craig ME (2017). Effect of Continuous Glucose Monitoring on Glycemic Control in Adults with Type 1 Diabetes Using Insulin Injections. The DIAMOND Randomized Clinical Trial, Journal of the American Medical Association, 317(4):371-378.
11. Juvenile Diabetes Research Foundation Continuous Glucose Monitoring Study Group. Bode B Beck RW, & et al. (2009). Sustained benefit of continuous glucose monitoring on A1c, glucose profiles, and hypoglycemia in adults with type 1 diabetes. Diabetes Care, 32: 2047-2049.
12. Beck RW, Riddlesworth TD, & et al (2017). Continuous Glucose Monitoring Versus Usual Care in Patients With Type 2 Diabetes Receiving Multiple Daily Insulin Injections A Randomized Trial. Annals of internal medicine, 167(6): 365-384.
13. Haak T, Hanaire H, & et al (2017). Flash Glucose-Sensing Technology as a Replacement for Blood Glucose Monitoring for the Management of Insulin-Treated Type 2 Diabetes: a Multicenter, Open-Label Randomized Controlled Trial, Diabetes Therapy, 8:55–73.
14. Oskarsson P, Autuna R, & et al (2018). Impact of flash glucose monitoring on hypoglycaemia in adults with type 1 diabetes managed with multiple daily injection therapy: a pre-specified subgroup analysis of the IMPACT randomised controlled trial. Diabetologia, 61: 539–550.
15. Skelly AC, Brodt ED, & et al. (2017). Continuous glucose monitoring – update, Final evident report. Washington State Health Care Authority.
16. Roze, S., Isitt, J., Smith-Palmer, J, & Lynch, P (2021). Evaluation of the Long-Term Cost-Effectiveness of the Dexcom G6 Continuous Glucose Monitor versus Self-Monitoring of Blood Glucose in People with Type 1 Diabetes in Canada. ClinicoEconomics and Outcomes Research, 13, 717-725.
17. Karter, A.J., Parker, M.M., Moffet, H.H., Gilliam, L.K., Dlott, R. (2021). Association of Real-time Continuous Glucose Monitoring With Glycemic Control and Acute Metabolic Events Among Patients With Insulin-Treated Diabetes Journal of the American Medical Association. 325 (22). E1-E12.
18. Kordonouri O, Pankowsha E, Rami B, & et al (2010). Sensor-augmented pump therapy from the diagnosis of childhood type 1 diabetes: results of the Paediatric onset study (ONSET) after 12 months of treatment. Diabetologia, 53: 2487-2495.

19. Wong JC, Foster C, & et al (2014). Real-time Continuous Glucose Among Participants in the T1D Exchange Clinic Registry, Diabetes Care, 37(10): 2702-2709.
20. National Collaborating Centre for Women's Children's Health (2015). Diabetes (Type1 and Type2) in children and young people: diagnosis and management.
21. Shah R, McKinlay CJ, and Harding JE et al (2018). Neonatal hypoglycemia: continuous glucose monitoring. Curr Opin Pediatr. 30(2): 204–208.
22. Battelino T, Conget I, Olsen B, & et al. (2012). The use and efficacy of continuous glucose monitoring in type 1 diabetes treated with insulin pump therapy: a randomized controlled trial. Diabetologia, 55: 3155-3162.
23. National Clinical Guideline Centre (2015). Type 1 Diabetes in Adult: Diagnosis and Management.
24. Ehrhardt NM, Chellappa M, Walker MS, Fonda SJ, Vigersky RA. The effect of real-Time continuous glucose monitoring on glycemic control in patients with type 2 diabetes mellitus. J Diabetes Sci Technol 2011; 5:668–675
25. Yoo HJ, An HG, Park SY, et al. Use of a real time continuous glucose monitoring system as a motivational device for poorly controlled type 2 diabetes. Diabetes Res Clin Pract 2008; 82:73–79
26. Martens T, et al.; MOBILE Study Group. Effect of continuous glucose monitoring on glycemic control in patients with type 2 diabetes treated with basal insulin: a randomized clinical trial. JAMA 2021; 325:2262–2272
27. Price DA, Deng Q, Kipnes M, Beck SE. Episodic real-time CGM use in adults with type 2 diabetes: results of a pilot randomized controlled trial. Diabetes Ther 2021;12:2089–2099
28. Evans M, Welsh Z, Ells S, Seibold A. The impact of flash glucose monitoring on glycaemic control as measured by HbA1c: a meta-analysis of clinical trials and real-world observational studies. Diabetes Ther 2020;11:83–95
29. Wada E, Onoue T, Kobayashi T, et al. Flash glucose monitoring helps achieve better glycemic control than conventional self-monitoring of blood glucose in non-insulin treated type 2 diabetes: a randomized controlled trial. BMJ Open Diabetes Res Care 2020;8:e001115
30. Yaron M, Roitman E, Aharon-Hananel G, et al. Effect of flash glucose monitoring technology on glycemic control and treatment satisfaction in patients with type 2 diabetes. Diabetes Care 2019; 42:1178–1184
31. Pratley, R.E., Kanapka, L.G., Rickels, M.R., et al. (2020). Effect of Continuous Glucose Monitoring on Hypoglycemia in Older Adults with Type 1 Diabetes. A Randomized Clinical Trial. Journal of American Medical Association. 323(23):2397-2406.
32. Bouillet, B., Tscherter, P., Vaillard, L., et al. (2021). Frequent and severe hypoglycaemia detected with continuous glucose monitoring in older institutionalized patients with

diabetes. Age & Ageing, 50(6), 2088-2093.
33. Hissa, M.R.N., Hissa, P,N,G Guimaraes, S.B., & Hissa M.N. (2021). Use of continuous glucose monitoring system in patients with type 2 mellitus diabetic during hemodialysis treatment. Diabetology and Metabolic Syndrome, 13(1), 1-10.
34. de Boer, I. H., & Rossing, P. (2020). Kidney Disease: Improving Global Outcomes (KDIGO) Diabetes Work Group. KDIGO 2020 Clinical Practice Guideline for Diabetes Management in Chronic Kidney Disease Introduction. KIDNEY INTERNATIONAL, 98(4), S20-+.
35. National Clinical Guideline Centre. (2015). Diabetes in pregnancy: Management of diabetes and its complications from preconception to the postnatal period.
36. Diabetes Technology: Standards of Medical Care in Diabetes Care 2022; 45 (Suppl.1) S97-S112
37. Feig DS, Donovan LE, Corcoy R, et al.; CONCEPTT Collaborative Group. Continuous glucose monitoring in pregnant women with type 1 diabetes (CONCEPTT): a multi-centre international randomised controlled trial. Lancet 2017; 390:2347–2359
38. Zaharieva, D.P., Teng, J.H., Ong, M.L., et al. (2020). Continuous Glucose Monitoring Versus Self-Monitoring of Blood Glucose to Assess Glycemix in Gestational Diabetes. Diabetes Technology Therapeutics. 22 (11), 822-827.
39. Rosa, G.M., Pamela, B.V., Beatriz, B., Noemi, G.P.V. (2022). Efficacy of continuous glucose monitoring on maternal and neonatal outcomes in gestational diabetes mellitus: a systematic review and meta-analysis of randomized clinical trials. Diabetic Medicine. 39 (1), 1-10

Chapter 3: Information of CGM

The following table summarizes the features and specificity of CGMS based on the user manuals and websites of different CGMS manufacturers.

Name	**Abbott-** **Freestyle Libre** [#1]	**Celki** **Dexcom 6**[#2]	**Medtronic** **Guardian Connect**[#43]
Sensor duration	14 days p10	10 days p82	7 full days p33
Transmitter	No	Yes p82	Yes p2
Receiver / Recorder	No p8 (Use Reader Device/Mobile App)	the mobile app or receiver, p12	No – Mobile App
Sensor Insertion Site	Arm p18 2.5cm (1 inch) away from injection site p18	Adult- Abdomen/Back of Arms Paedi (2-17) – Abdomen/Back of Arms/ upper buttocks p9 At least 8cm from insulin pump infusion set or injection site p10	Avoid the 2 inches (5.0 cm) area around the navel p9 An insertion site that has an adequate amount of subcutaneous fat – abdomen and back of upper arm p9
Start-up time (Initiation with finger prick glucose)	1 hour (1 hour after insertion) p22	No need finger prick (2 hr sensor warm-up) p7	2 hours (2 hours after installation 2 finger sticks) p29
Calibration	No (Need to scan the sensor at least once every 8 hours) p76	No need p7	Yes, BG for 1st calibration within 2 hours, 2nd calibration within 6 hours, and subsequently every 12 hours p29
Real-time display - sensor glucose, graphic and trend	Yes, 2.2 – 27.8 mmol/L p75, but graph displays glucose readings up to 21 mmol/L (glucose values over 21 mmol/L displayed at 21 mmol/L) p25	Yes, 2.2 – 22.2 mmol/L p82	Yes, 2.2 – 22.2 mmol/L p69
Data capture (Glucose reading update)	Every 1 minute, record at every 15 minutes[2]	Every 5 minutes p.21	Every 5 minutes p46
Accuracy	During times of rapidly changing glucose (more than 0.1 mmol/L per minute), sensor glucose may not be accurate and require blood glucose test p4	Calibration code should be entered when inserting sensor. p7 Calibration is not required but optional. p33	Calibrate three to four times at regular intervals throughout the day to improve accuracy. entering BG value immediately after BG test p30

Software/ Download Capability	Freestyle Libre Desktop software/ LibreView Web-based[2]	Dexcom G6 Mobile app p12 / Dexcom CLARITY® (Mobile app/ web-based program) p70	Guardian Connect app p2
DM population	4 years old and older (4-17 supervised by adult) p3	Age 2 and older including pregnant women p5	Age 14-75 years old p1
Approved for insulin adjustment without finger prick	Not mention	Yes p5	No p5
Confirmation with finger prick blood glucose if hypoglycemia	Yes p4 or appear in the screen	No, but need to cross check if any discrepancy from symptoms p33	Yes p30
Removed before MRI/CT/ Diathermy, other devices to generate strong magnetic fields or ionizing radiation	• Yes and also under X-ray machine p7 • Not mention diathermy	Yes p5	Yes also under X-ray machine p7
Alert system	Not available	Yes, Do not expect alerts until after 2-hour warm up p26	Yes, alert on or before high (5.6 – 22 mmol/L) or low (3.3-5 mmol/L) up to 60 min p32,36,37 Raise alert: One arrow signals a 1 mg/dL (0.06 mmol/L) rise; two arrows signal a 2 mg/d (0.11 mmol/L) rise; and three arrows signal a 3 mg/dL (0.17 mmol/L) rise Fall alert: One arrow signals a 1 mg/dL (0.06 mmol/L)fall; two arrows signal a 2 mg/dL (0.11 mmol/L) fall; and three arrows signal a 3 mg/dl (0.17 mmol/L), fall p32,38

Sensor storage	4°C to 25°C p6 Relative humidity 10 -90% p76	2° C-30° C Store sensors in a cool dry place p82	2 °C to 27 °C p22
Waterproof/ Water resistant	Do not immerse sensor deeper than 1 metre (3 feet) or longer than 30 minutes in water (1 meter 30 min) p60	Transmitter is IP28 (Protection against insertion of large objects greater than 12.5mm and immersion in water for up to 2.4 meters for 24 hours) Sensor with attached transmitter is water resistant. No limitation for swim, bathe or shower. p65	After the transmitter and sensor are connected, they form a waterproof seal to a depth of 8 feet (2.4 meters) for up to 30 minutes p53
Receiver distance	To scan the sensor, the reader is held 1cm to 4 cm above the sensor p23	Keep transmitter and display device within 6 meters with no obstacles (like walls or metal) in between. Range is less under water. p12	Keep the distance between the transmitter and the compatible mobile device to <20 feet (6.1 meters) p10
Additional feature	Built-in meter for blood glucose and blood ketone test p8, blood glucose range 1.1 - 27.8 mmol/L p45, also insulin calculator for rapid acting insulin Reader can store approximately 90 days of glucose reading and notes p9 Mobile apps can replace reader and share 20 smart devices/HPC/Relatives[12]	Mobile communication through blue-tooth and Apps for 5 smart devices / HCP / Relatives p39	Mobile communication through blue-tooth and Apps for 5 smart devices / HCP / Relatives p20
Interference substances	ascorbic acid (vitamin C) – falsely high; salicylic acid – slightly low[1] p6	No Paracetamol/ acetaminophen interference (within daily max dosage). p3 Hydroxyurea may be falsely elevated p7	Taking medications with paracetamol / acetaminophen – falsely high p6

Warning	Not evaluated for use in • Pregnant women • Persons on dialysis • with other implanted medical device p5 • Patients with hypoglycemic unawareness p2 • Severe dehydration may cause inaccurate results p6	Not approved for use on people: • on dialysis • critically Ill p6	Continuous glucose monitoring is not recommended for people who are unwilling or unable to perform a minimum of two meter blood glucose tests per day or for people who are unable or unwilling to maintain contact with their healthcare professionals p3
Cross checking Glucose	• Rapidly changing glucose level, interstitial glucose not accurately reflecting blood glucose[5] • Need finger stick glucose to confirm hypo/ hyperglycaemia and insulin dose adjustment [1 p47] (except Dexcom G6 for treatment decision)[2p7,11] • If readings do not match symptoms, cross check with fingerstick glucose[2p49]		
Skin reaction	Possible risks: skin allergy, bleeding, swelling, irritation and or infection[1p25, 2p51,3p12]		
Travelling	Notify security personnel to perform a visual inspection instead of through the x-ray[1p68, 2p11] Freestyle Libre - Not to scan or turn on reader on flight and check finger prick glucose/ketone[1 p68]		

* Insertion site: Avoid areas with scars, moles, stretch marks, or lumps. Select an area of skin that generally stays flat during normal daily activities (no bending or folding)[3 p9].

Dexcom 6 [2] – G6 transmitters last for 3 months. A message will be displayed on the screen of the smart phone if the transmitter is going to expire in 3 weeks. [p38] The receiver is rechargeable and it takes about 3 hours for full charge, and the rechargeable battery will last about 2 days. [p82-83]

Guardian Connect[3] – Use life: transmitter can be cleaned up to 122 times or one year. If you continue to use the transmitter beyond 122 times or one year, the cleaning process may damage the device[p50]. The transmitter contains a non-replaceable, rechargeable battery that you can recharge as needed with the charger. The charger needs one AAA alkaline battery. The transmitter will need to be charged before you use it[p12]. A fully charged transmitter works at least seven days without recharging. If the transmitter is left on the charger for more than 60 days, the battery will be permanently damaged[p13.]

#All the page numbers refer to those in the respective product manual.

References: (information of CGM)

1. Abbott (2016). User manual of Freestyle Libre Flash blood glucose monitoring system. ©2016 Abbott.
2. Dexcom (2019). User's Guide Dexcom G6®.
3. Medtronic (2018). Guardian Connect system user guide.
4. Abbott (2017). FreeStyle Libre System IN-SERVICE GUIDE.
5. E Cengiz & WV. Tamborlane (2009). A Tale of Two Compartments: Interstitial Versus Blood Glucose Monitoring. Diabetes Technology & Therapeutics, 11(S1), S11-16.

Chapter 4: Nursing Practice Guide for Continuous Glucose Monitoring (CGM)

There has been rapid advancement of CGM technology in recent years including accuracy, simple procedures of sensor insertion, diminished frequency of sensor calibration, and reducing cost of CGM. Level VA

Real time CGM (rtCGM) provides instant glucose reading, glucose trend of previous few hours and rate of change (trend) arrow to facilitate daily management decision-making by the patient and retrospectively, the ambulatory glucose profile (AGP) data report in clinic visit as well[1].

Randomized control trials (RCTs)[2-11] have demonstrated the effectiveness of rtCGM on improving HbA1c, reducing hypoglycaemia exposure and prevention of hypoglycemia in Type 1 and Type 2 diabetes undergoing intensive therapy and using it on nearly daily basis. Level IA

However, there were some barriers to using rtCGM from user's perspective in an observational study which might explain the reason for the large drop-out rate in some studies[12]. When we look into the inclusion and exclusion criteria of patient recruitment, the patients were required to have self-monitoring blood glucose (SMBG) regularly such as 2 times a day or 75% usage of rtCGM before randomization. Some studies necessitated patient assessment for the willingness and ability of using rtCGM or knowledge on diabetes management. Therefore, the following considerations should be made when diabetes nurses assess patient's readiness of using rtCGM: Level IIIA

i) Knowledge of diabetes management
ii) Financial Status
iii) self-efficacy of performing self-monitoring blood glucose

Practical Checklist [13-14] Level VB

1. Before introducing Real time CGM (rtCGM), we need to assess the following items:

1.1 Medical history and treatment
1.2 Pattern of using CGM – regular or intermittent
1.3 Readiness of using CGM for reviewing the glucose excursions and self-efficacy of performing self-monitoring blood glucose
1.4 Ability of handling the CGM technology
1.5 Knowledge of diabetes management

Education on Real time CGM (rtCGM) [12-13] Level VB

1. Before rtCGM installation

1.1 The difference between interstitial fluid glucose and capillary blood glucose
1.2 Setting up the goal of using rtCGM
1.3 The importance of keeping record on medications, diet, exercise and hypoglycemia .
1.4 The relationship of rtCGM accuracy with the proper technique, frequency and timing of SMBG tests for calibration (SMBG for calibration should be avoided at times of rapid glucose change)
1.5 Reviewing the technique of self-monitoring of blood glucose (SMBG) and equipment conditions to ensure high quality data
1.6 The reason for using capillary blood glucose to confirm hypoglycemia
1.7 The reason for lower interstitial fluid glucose than capillary blood glucose in the initial few hours
1.8 The display information including glucose reading, glucose trend of previous few hours and arrow trends (rate of change (ROC) according to the manufacturer's information)
1.9 Reviewing or intensifying education on Insulin to carbohydrate ratio (ICR), insulin sensitivity factor (ISF), insulin dose adjustment principles and safety using the ROC to optimize glycemic control for diabetes patients on intensive treatment (CSII or MDI)
1.10 Providing insight into the effects of medications and lifestyle choices
1.11 Teaching the meaning of ROC to predict and prevent hypoglycemia through appropriate action in type 2 DM subjects on basal insulin and OADs
1.12 CGM sensor placement according to manufacturer's instruction

2. After completion of rtCGM

2.1 Reviewing the quality of rtCGM data and identifying the important information including glucose pattern, hypoglycemia during day and night time (awareness and unawareness), glucose variability and stability

2.2 Discussing the report with patient's daily record to find out any modifiable behavior from the patient and evaluating the immediate management or treatment decision in daily life

2.3 Evaluating the appropriateness of ICR and ISF for fine adjustment

2.4 Picking up some special events such as intensive and long duration exercise, and sick days for education

2.5 Installing the software to download the personal continuous glucose profile report and providing education for self-evaluation and lifestyle modification

2.6 Recording the findings in medical record

Key points for patient preparation and education Level VB

1. **Pre-CGM Initiation**
   - 1.1 The difference between interstitial fluid and capillary glucose, and how this explains for the lag time
   - 1.2 The limitation in rtCGM data accuracy within the first 24 hours of insertion
   - 1.3 Realistic goal of using CGM
   - 1.4 Managing emotions around glycemic excursions
   - 1.5 Insulin action time and expected post-meal patterns if applicable
2. **Calibration**
   - 2.1 The importance of handwashing prior to fingerstick monitoring
   - 2.2 Calibration intervals and proper technique to ensure the accuracy
3. **Sensor insertion procedure and placement**
   - 3.1 According to the CGM user manual
4. **rtCGM display** information [15]
   - 4.1 The significance of alarm/alerts, glucose trend data and trend arrows in making treatment decision
   - 4.2 How to use the trend arrows in individual treatment decision
5. **Cross Checking Glucose**
   - 5.1 At times of rapidly changing glucose levels when interstitial glucose does not accurately reflect blood glucose. Testing of blood glucose with the blood glucose analyser to confirm hypoglycemia/hyperglycemia, especially when there is symptom discrepancy
6. **Log Sheet Entries**
   - 6.1 Recording SMBG readings, food intake, physical activity and duration, medications and dosage, and other events (such as hypoglycemic symptoms, stress, or illness)

References:

1. Anders L. Carlson, MD, Deborah M. Mullen, PhD, and Richard M. Bergenstal, MD (2017). Clinical Use of Continuous Glucose Monitoring in Adults with Type 2 Diabetes. Diabetes Technology & Therapeutics,19,(S2):S4-S11.
2. Skelly AC, Brodt ED et al (2017). Continuous glucose monitoring – update, Final evident report. Washington State Health Care Authority.
3. Danne T, Nimri R et al (2017). International Consensus on Use of Continuous Glucose Monitoring, Diabetes Care, 40, 1631-1640.
4. Twigg SM, Kazemi MR & Craig ME (2017). Self-measurement of Blood Glucose and Continuous Glucose Monitoring – Is There Only One Future? Eur Endocrinol. 2018 Sep; 14(2): 24–29.

5. Oskarsson P, Autuna Ret al (2018). Impact of flash glucose monitoring on hypoglycaemia in adults with type 1 diabetes managed with multiple daily injection therapy: a pre-specified subgroup analysis of the IMPACT randomised controlled trial, Diabetologia,61:539–550.
6. Riveline JP, Schaepelynck P et al (2012). Assessment of Patient-Led or Physician-Driven Continuous Glucose Monitoring in Patients with Poorly Controlled Type1 Diabetes Using Basal-Bolus Insulin Regimens. Diabetes Care 2012 May; 35(5): 965-971.
7. Lind M, Polonsky W et al (2016). Design and Methods of a Randomized Trial of Continuous Glucose Monitoring in Persons with Type 1 Diabetes With Impaired Glycemic Control Treated With Multiple Daily Insulin Injections (GOLD Study), Journal of Diabetes Science and Technology 2016, Vol. 10(3) 754–761.
8. Beck RW, Riddlesworth TD et al (2017). Continuous Glucose Monitoring Versus Usual Care in Patients with Type 2 Diabetes Receiving Multiple Daily Insulin Injections. A Randomized Trial, Annals of internal medicine 167(6).
9. Beck RW, Riddlesworth TD et al (2017). Effect of Continuous Glucose Monitoring on Glycemic Control in Adults with Type 1 Diabetes Using Insulin Injections: The DIAMOND Randomized Clinical Trial, JAMA,317(4):371-378.
10. Haak T , Hanaire H et al (2017). Flash Glucose-Sensing Technology as a Replacement for Blood Glucose Monitoring for the Management of Insulin-Treated Type 2 Diabetes: a Multicenter, Open-Label Randomized Controlled Trial, Diabetes Ther (2017) 8:55–73.
11. Bolinder J & Antuna R et al (2018). Impact of flash glucose monitoring on hypoglycaemia in adults with type 1 diabetes managed with multiple daily injection therapy: a pre-specified subgroup analysis of the IMPACT randomised controlled trial, Diabetologia (2018) 61:539–550.
12. Wong JC, Foster C et al (2014). Real-Time Continuous Glucose Monitoring Among Participants in the T1D Exchange Clinic Registry, Diabetes Care 2014 Oct; 37(10): 2702-2709
13. AADE (2015). AADE Continuous Glucose Monitoring Summit White Paper.
14. Aleppo G & Laffel LM et al (2017). A Practical Approach to Using Trend Arrows on the Dexcom G5 CGM System for the Management of Adults with Diabetes, Journal of the Endocrine Society, 1(12): 1445-1460.
15. Pettus J & Edelman V (2017). Recommendations for using real-time continuous glucose monitoring data for insulin adjustment in type 1 diabetes, Journal of Diabetes Science and Technology, 11(1): 138–147.

Chapter 5: Patient Education Materials

We incorporate expert recommendation and information from CGMS manuals and websites of different manufacturers to prepare the following patient education materials.

General Patient Information Sheet for continuous glucose monitoring (CGM)

1 What is CGM?

The sensor contains a wire with a supply of glucose oxidase at the tip which is inserted in subcutaneous tissue. Glucose oxidase catalyses a biochemical reaction in the presence of glucose and oxygen that transfers electrons to a receiving molecule and creates an electronic current, whose magnitude can be measured and converted into a glucose concentration. The device calculates and stores glucose readings every 5 minutes and shows the glucose graphic by 288 readings in 24 hours.

2 Pre-CGM Initiation

2.1 **Education and training are required for patients to benefit from CGM**

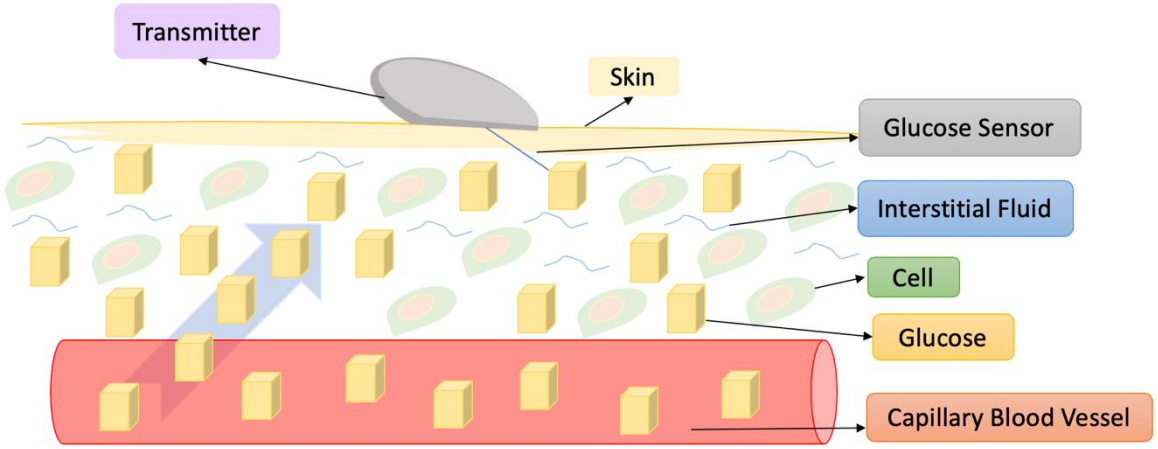
2.2 The goal of using CGM:
To understand the relationship between medications, diet and exercise for the individual with the glucose graphic, health care professional would recommend the following individually according to the patient's conditions:

2.2.1 Type of continuous glucose monitoring system:
☐ Real-time CGMS

2.2.2 Using pattern
☐ Intermittent use for adjusting the treatment plan for diabetes
☐ Long term use for monitoring glucose level, detecting hypoglycemia, diet modification and learning bolus insulin adjustment

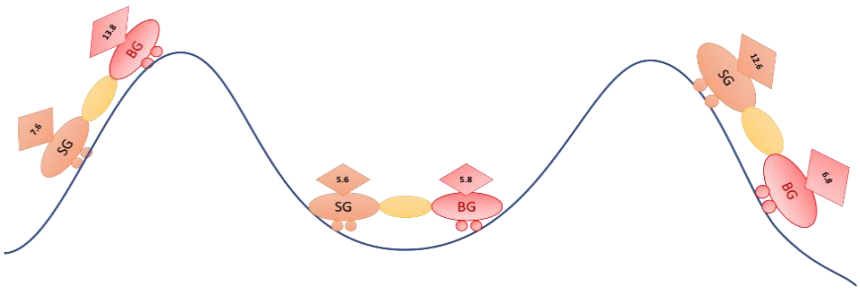
2.3 Special precaution

2.3.1 The difference between interstitial fluid and capillary blood glucose and physiological lag time



Physiological lag time between SG and BG~5-10 minutes

2.3.2 Great difference between blood glucose and senor glucose value while rapid changes



SG = sensor glucose
BG = blood glucose

3 Installation of CGMS

3.1 Calibration

3.1.1 A CGM device should be calibrated according to the manufacturer's instructions

3.1.2 The calibration should be done at times of stable glucose levels, e.g fasting or pre-meals, and according to the recommended interval to ensure the accuracy of CGM

3.1.3 CGM accuracy depends on the quality of blood glucose test data

3.1.4 Patients should ensure to follow the instruction of individual blood glucose meter, proper storage of test strips and use before the expiry date.

3.1.5 Patients must ensure their hands are clean and dry (no lotion or cream on the skin) and the blood sample is sufficient for a test (some glucose meters will return a falsely low value when not enough blood is applied)

3.1.6 Patients should enter the blood glucose test result for calibration as soon as possible

3.2 Patients should perform the blood glucose tests for treatment decision and insulin dose adjustment in the event of:

3.2.1 Symptoms and signs of hypoglycemia or hyperglycemia

3.2.2 Unmatched symptoms and signs with sensor glucose value

3.2.3 Rapid changes of sensor glucose

3.2.4 Sensor glucose below 4 mmol/L

4 After Installation of CGMS

4.1 Log Sheet Entries

4.1.1 Recording the BG meter readings, food items and amount, number of carbohydrates, physical activity and duration, medications and dosage, and other events (such as symptoms of hypoglycemia and management, stress, or illness).

4.1.2 Advising the patient to keep the log sheet at all times so he/she can write down the information immediately after each event. Record the time and date within 5 minutes of each BG meter reading.

4.2 Skin Reaction

4.2.1 Possible risks: skin allergy, bleeding, swelling, itchy, blister and or infection

4.2.2 Causes for skin irritation: sensor probe, sensor tape, additional tape, adhesive aid

4.2.3 Removing the sensor and notifying the doctor or diabetes nurse

4.3 Travelling

4.3.1 Medical certificate for use of CGMS

4.3.2 Notify security personnel and contact aviation authority

4.4 CT Scan/MRI/Diathermy/other devices which generate strong magnetic fields or ionizing radiation

4.4.1 Remove before the captioned examination and procedure

4.5 Sensor Life

4.5.1 Recommendation of sensor duration according to respective user guides.

4.5.2 Sensor decay >20% variation from SMBG, poor signal transmission and also association with skin infection/irritation if prolonged use

病人使用連續性葡萄糖監察系統須知

1 何為連續性葡萄糖監察系統？

是應用電化學反應，將葡萄糖感應器的幼軟管植入皮下組織，通過感應器上的糖氧化酶每 5 分鐘測量皮下組織液內氧的消耗或氫氧離子產生的電流訊號，透過葡萄糖接收器，將電流訊號轉換成葡萄糖數值。每五分鐘記錄一次平均葡萄糖值，在 24 小時獲得 288 個於組織液的葡萄糖值並連成曲線呈現葡萄糖趨勢圖。

2 安裝連續性葡萄糖監察系統前

使用前需要接受教育及訓練，充分發揮此系統的優點：

2.1 使用此系統的目的

透過趨勢圖明白藥物、食物及運動對個別糖尿病人的影響，醫護人員亦會因應不同的情況作出下列建議：

2.1.2 連續性葡萄糖監察系統

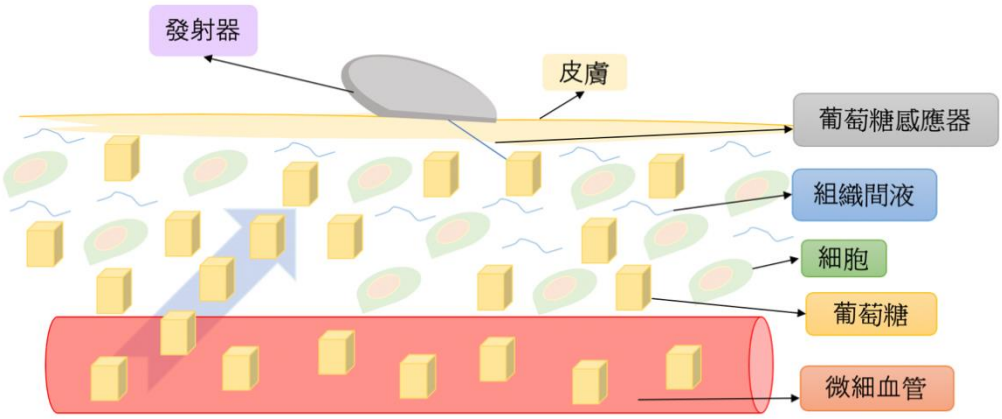
- ☐ 實時連續性葡萄糖監察系統

2.1.2 使用時間性

- ☐ 間斷性地評估血糖趨勢以調整糖尿病的治療方案
- ☐ 長期性地跟進血糖趨勢以監察低血糖反應，自行在飲食及餐前胰島素進行調節

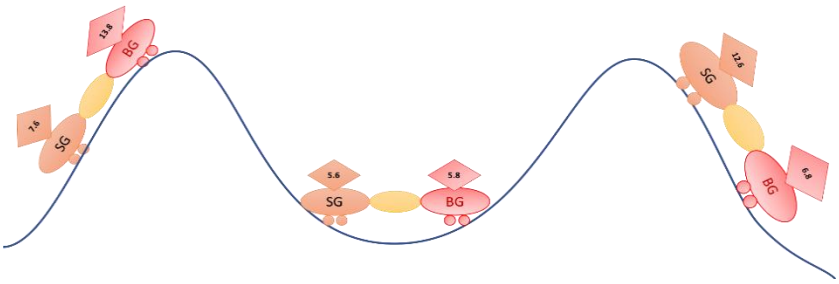
2.2 特別注意事項

2.2.1 微血管葡萄糖與組織液葡萄糖的分別及生理性的時間差距



在生理上，感應器葡萄糖值反應會延遲微血管葡萄糖值5 – 10 分鐘

2.2.2 微血管葡萄糖值及感應器葡萄糖值在血糖快速轉變時差距擴大



SG = 感應器葡萄糖值
BG= 微血管葡萄糖值

3 安裝連續性葡萄糖監察系統

3.1 系統較正

3.1.1 跟從所使用系統的要求，定時進行血糖測試作較對
3.1.2 進行較對必須在血糖較穩定如空腹或餐前時，並要跟從個別系統的要求較對次數以確保連續性葡萄糖監察準確
3.1.3 連續性葡萄糖監察系統的準確性有賴準確血糖測試結果
3.1.4 確保血糖機操作正常、血糖測試紙儲存在正確及在有效期內
3.1.5 測試血糖前必須洗手及抹乾，測試程序必須正確
3.1.6 血糖測試結果要盡快輸入接收器作較正

3.2 在下列情況需要進行血糖測試以決定治療行動及調整餐前胰島素劑量

3.1.1 出現有血糖過高或過低的徵狀
3.1.2 出現的徵狀與顯示的感應器葡萄糖值不吻合
3.1.3 當感應器葡萄糖值有快速的改變時
3.1.4 感應器葡萄糖值低於 4 mmol/L

4 安裝連續性葡萄糖監察系統後

4.1 填寫記錄表

4.1.1 記錄藥物劑量、食物種類和份量、運動時間和強度、低血糖徵狀和處理方法以及患病和壓力事情等作為分析葡萄糖趨勢變化的原因
4.1.2 隨身攜帶記錄簿盡快填寫所有資料或利用手機應用程式作完整記錄

4.2 皮膚反應

4.2.1 留意皮膚可能出現的問題：皮膚過敏、出血、腫脹、痕癢、水泡或發炎
4.2.2 出現皮膚刺激反應的原因：感應器軟管、感應器膠布、另加膠布或輔助黏貼用品
4.2.3 要移除感應器並通知醫護人員

4.3 外遊

4.3.1 攜帶需要使用連續性葡萄糖監察系統醫療證明文件

4.3.2 主動通知安檢人員及航空公司

4.4 電腦斷層掃描/磁力共振/透熱療法/其他高磁場或離子放射線程序

4.4.1 進行以上檢驗或程序前必須先行移除感應器

4.5 感應器時限

4.5.1 跟從個別系統的使用指引不能超越安裝感應器時限

4.5.2 超越安裝感應器時限會使接收器電流訊號減弱或皮膚出現刺激反應／發炎

Reference

1. AADE (2015). AADE Continuous Glucose Monitoring Summit White Paper.
2. E Cengiz & WV. Tamborlane. (2009) A Tale of Two Compartments: Interstitial Versus Blood Glucose Monitoring. Diabetes Technology & Therapeutics, 11(S1), S11-16.
3. User's Guide Dexcom G4® Platinum Continuous Glucose Monitoring System© 2014 Dexcom, inc.
4. User guide for Dexcom G5® mobile continuous glucose Monitoring (CGM) system © 2017 Dexcom, Inc.
5. Medtronic (2018). Guardian Connect system user guide
6. Lombardo F, Salzano G, Crisafulli G, et al. (2020) Allergic contact dermatitis in pediatric patients with type 1 diabetes: An emerging issue. Diabetes Research & Clinical Practice, 162:108089.

General Patient Information Sheet for intermittently scanned continuous glucose monitoring (isCGM)

1. What is isCGM?

The sensor contains a wire with a supply of glucose oxidase enzyme at the tip which is inserted into subcutaneous tissue. However, the system utilizes the Wired Enzyme technology by which the enzyme is cross-linked with mediator molecules (an osmium complex) into a polymer matrix. Glucose which diffuses from the interstitial tissue through the outer membrane into the enzyme matrix is oxidized by glucose oxidase, the resulting electrons are then retrieved by the osmium mediator to provide direct signalling to the sensor electrode and generate a glucose value. Also this system is factory-calibrated during the manufacturing process and does not require blood glucose testing for calibration. The device measures glucose levels every minute and records every 15 minutes, user must scan the sensor with a reader to get the current glucose value. Glucose data of the most recent 8 hours are stored in the sensor and provide the glucose trend in the reader/mobile app.

2. Pre-isCGM Initiation

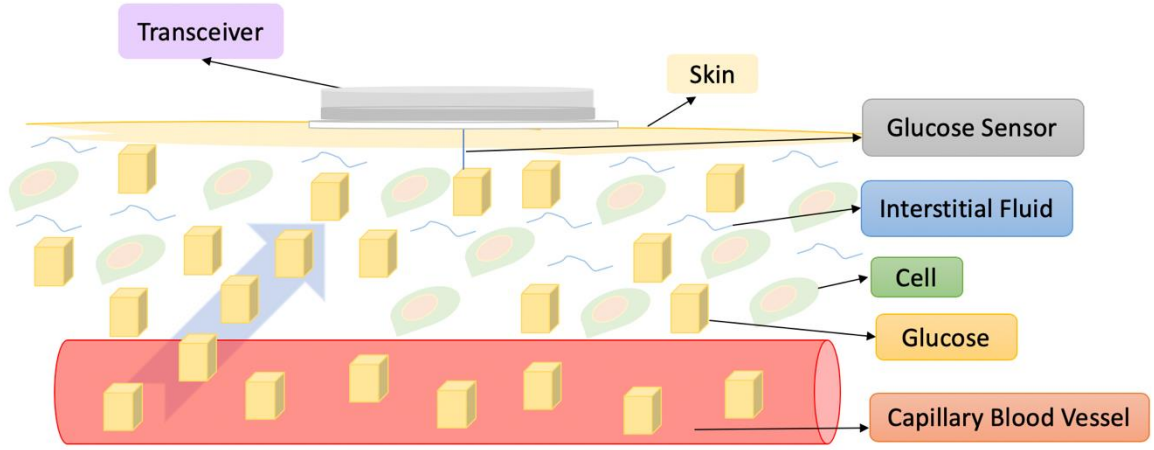
2.1 Education and training are required for patients to benefit from CGM.

2.2 The goal of using isCGM:
Understanding the relationship between medications, diet and exercise for the individual with the glucose graphic, health care professional would recommend the following option according to the patient's condition:

2.2.1 Type of continuous glucose monitoring system:
☐ Real-time isCGM

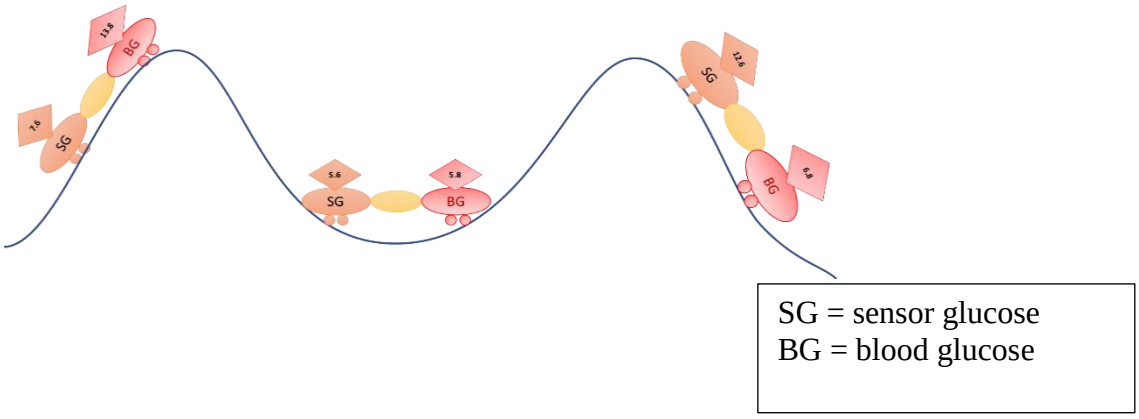
2.2.2 Using pattern
☐ Intermittent use for adjusting the treatment plan for diabetes
☐ Long term use for monitoring glucose trend, detecting hypoglycemia, diet modification and learning bolus insulin adjustment

2.3 Special precaution
2.3.1 The difference between interstitial fluid and capillary blood glucose and physiological lag time



Physiological lag time between SG and BG~5-10 minutes

2.3.2 Great difference between blood glucose and sensor glucose value while rapid changes



3. Installation of isCGM

3.1 Scanning the glucose reading

3.1.1 Sensor can save glucose data for 8 hours

3.1.2 Patients should scan the sensor with the reader or mobile phone for glucose level at least once every 8 hours

3.1.3 The reader / mobile app shows the current glucose reading and the glucose graphic trend in past 8 hours

3.1.4 Glucose data prior to the previous 8 hours will be lost if the sensor is not scanned for more than 8 hours

3.1.5 The reader can save glucose data history for 90 days

3.1.6 Patients should ensure the normal function of blood glucose meter, proper storage of test strips and use before the expiry date

3.1.7 Patients must ensure their hands are clean and dry, and also perform the blood glucose tests properly

3.2 Patients should perform the blood glucose tests for treatment decision and insulin dose adjustment in the event of:

3.2.1 Symptoms and signs of hypoglycemia or hyperglycemia

3.2.2 Unmatched symptoms and signs with sensor glucose value

3.2.3 Rapid changes of sensor glucose

3.2.4 Sensor glucose below 4 mmol/L

4 After Installation of CGMS

4.1 Log Sheet Entries

4.1.1 Recording the BG meter readings, food items and amount, number of carbohydrates, physical activity and duration, medications and dosage, and other events (such as symptoms of hypoglycemia and management, stress, or illness)

4.1.2 Advising the patient to keep the log sheet at all times so he/she can write down the information immediately after each event. Record the time and date within 5 minutes of each BG meter reading

4.2 Skin Reaction

4.2.1 Possible risks: skin allergy, bleeding, swelling, itchy, blister and or infection

4.2.2 Causes for skin irritation: sensor probe, sensor tape, additional tape, adhesive aid

4.2.3 Removing the sensor and notifying the doctor or diabetes nurse

4.3 Travelling

4.3.1 Medical certificate for use of CGMS
4.3.2 Notify security personnel and contact aviation authority

4.3.3 Performing blood glucose monitoring instead of scanning the sensor while on plane

4.4 X-Ray/CT Scan/MRI/other devices which generate strong magnetic fields or ionizing radiation

4.4.1 Remove before the captioned examination and procedure

4.5 Sensor Life

4.5.1 Recommendation of sensor duration according to respective user guides

4.5.2 Sensor decay >20% variation from SMBG, poor signal transmission and also association with skin infection/irritation if prolonged use

病人使用間歇掃描式葡萄糖監察系統須知

1. **何為間歇掃描式葡萄糖監察系統？**

是應用電化學反應，將葡萄糖感應器的幼軟管植入皮下組織，利用聯網酵素技術(wired enzyme technology) ，軟管上的糖氧化酶只會結合葡萄糖，並將電子信號直接輸送到感應器的電極，轉化成葡萄糖數值。每分鐘測量皮下組織液葡萄糖數值，每十五分鐘記錄一次平均葡萄值，感應器能存儲 8 小時的葡萄糖值數據，所以每 8 小時必須掃描感應器一次，將數據傳送到閱讀器可儲存 90 日。儲存的葡萄糖值會連成曲線呈現葡萄糖趨勢圖。此外，這系統在生產過程已進行葡萄糖值較正，不需每天進得血糖測試作系統較正。

2. **安裝間歇掃描式葡萄糖監察系統前**

使用前需要接受教育及訓練，明白使用此系統的優點，包括：

2.1 使用此系統的目的

透過趨勢圖明白藥物、食物及運動對個別糖尿病人的影響，醫護人員亦會因應不同的情況作出下列建議：

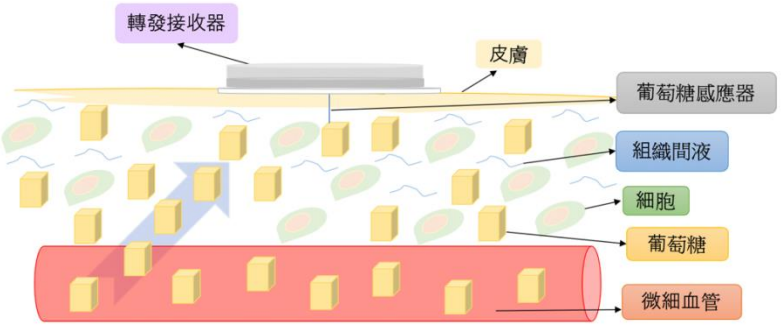
2.1.1 實時間歇掃描式葡萄糖監察系統

2.1.2 使用時間性

- □ 間斷性地評估血糖趨勢以調整糖尿病的治療方案
- □ 長期性地跟進血糖趨勢以監察低血糖反應，自行在飲食及餐前胰島素進行調節

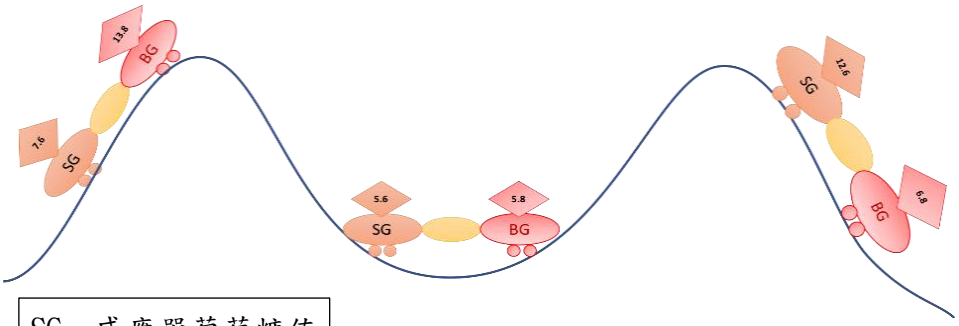
2.2 特別注意事項

2.2.1 微血管葡萄糖與組織液葡萄糖的分別及生理性的時間差距



在生理上，感應器葡萄糖值反應會延遲微血管葡萄糖值5 – 10 分鐘

2.2.2 微血管葡萄糖值及感應器葡萄糖值在血糖快速轉變時差距擴大



SG =感應器葡萄糖值
BG= 微血管葡萄糖值

3. 安裝間歇掃描式葡萄糖監察系統

3.1 葡萄糖值儲存系統

3.1.1 感應器可以儲存 8 小時的葡萄糖值資料
3.1.2 跟從所使用系統的要求，最少每 8 小時自行掃描感應器一次
3.1.3 每次掃描會顯示即時葡萄糖值及過去 8 小時的葡萄糖趨勢曲線圖
3.1.4 若超過 8 小時進行掃描感應器，會失去 8 小時以前的葡萄糖值資料
3.1.5 將葡萄糖值儲存在閱讀器內可保存 90 日
3.1.6 確保血糖機操作正常、血糖測試紙儲存在正確及在有效期內
3.1.7 測試血糖前必須洗手及抹乾，測試程序必須正確

3.2 在下列情況需要進行血糖測試以決定治療行動及調整餐前胰島素劑量

3.2.1 出現有血糖過高或過低的徵狀
3.2.2 出現的徵狀與顯示的感應器葡萄糖值不吻合
3.2.3 當感應器葡萄糖值有快速的改變時
3.2.4 感應器葡萄糖值低於 4mmol/L

4. 安裝間歇掃描式葡萄糖監察系統後

4.1 填寫記錄表

4.1.1 記錄藥物劑量、食物種類和份量、運動時間和強度、低血糖徵狀和處理方法以及患病和壓力事情等作為分析葡萄糖趨勢變化的原因
4.1.2 隨身攜帶記錄簿盡快填寫所有資料或利用手機應用程式作完整記錄

4.2 皮膚反應

4.2.1 留意皮膚可能出現的問題：皮膚過敏、出血、腫脹、痕癢、水泡或發炎
4.2.2 出現皮膚刺激反應的原因：感應器軟管、感應器膠布、另加膠布或輔助黏貼用品
4.2.3 要移除感應器並通知醫護人員

4.3 外遊

4.3.1 攜帶需要使用間歇掃描式葡萄糖監察系統醫療證明文件

4.3.2 主動通知安檢人員及航空公司

4.3.3 在機上要進行血糖測試代替掃描葡萄糖值

4.4 X 光/電腦斷層掃描/磁力共振/其他高磁場或離子放射線程序

4.4.1 進行以上檢驗或程序前必須先行移除感應器

4.5 感應器時限

4.5.1 跟從個別系統的使用指引不能超越安裝感應器時限

4.5.2 超越安裝感應器時限會使接收器電流訊號減弱或皮膚出現刺激反應／發炎

Reference

1. AADE (2015). AADE Continuous Glucose Monitoring Summit White Paper.
2. E Cengiz & WV. Tamborlane. (2009) A Tale of Two Compartments: Interstitial Versus Blood Glucose Monitoring. Diabetes Technology & Therapeutics, 11(S1), S11-16.
3. FreeStyle Libre System IN-SERVICE GUIDE ©2017 Abbott. ADC-05821 v2.0 10/17
4. User manual of Freestyle Libre Flash blood glucose monitoring system ©2017 Abbott.
5. Lombardo F, Salzano G, Crisafulli G, et al. (2020) Allergic contact dermatitis in pediatric patients with type 1 diabetes: An emerging issue. Diabetes Research & Clinical Practice, 162:108089.

Patient Information on Using FreeStyle Libre Flash Glucose Monitoring System



Sensor Duration	14 days
Sensor Insertion Site	1) Apply sensors only on the back of upper arm. Avoid areas with scars, moles, stretch marks or lumps. 2) Select an area of skin that generally stays flat during normal daily activities (no bending or folding). Choose a site that is at least 2.5 cm (1 inch) away from an insulin injection site. To prevent discomfort or skin irritation, you should select a different site other than the one most recently used. 
Calibration	No calibration is necessary Finger prick blood glucose testing would still be needed: 1) During times of rapidly changing glucose levels (as indicated by up or down arrows) when interstitial fluid glucose levels may not accurately reflect blood glucose levels 2) If FreeStyle Libre shows hypoglycaemia or impending hypoglycaemia 3) When symptoms do not match the system readings For a full 24 hours of data, users must scan the sensor at least once every 8 hours
Sensor Storage	4°C to 30°C, relative humidity 10-90%
Waterproof/ Water Resistant	The sensor is waterproof in up to 1 meter of water for 30 minutes and can be worn during all daily activities including bathing and showering.
Receiver Distance	To scan the sensor, the reader is held 1 to 4cm above the sensor for 1 second
Additional Feature	1) Built-in meter for blood glucose and blood ketone test, also insulin calculator for rapid acting insulin. 2) The reader is reusable and has rechargeable battery that must be charged every 7 days. 3) Do not scan the sensor or power on the reader using the Home Button while flying, if restricted by flight regulations. Insert a strip to perform a blood glucose or ketone test. 4) The reader is for use by a single person. It must not be used on more than one person including other family members due to risk of spreading infection.

Precaution	1) Taking ascorbic acid (vitamin C) - readings falsely high / salicylic acid - slightly low 2) Libre senor must be removed prior to X-ray, CT scan or MRI examination
Accuracy	falsely low estimation in 1st 24 hours
Approved for insulin adjustment without finger prick	No

Reference: FreeStyle Libre User Manual ©2022 Abbott

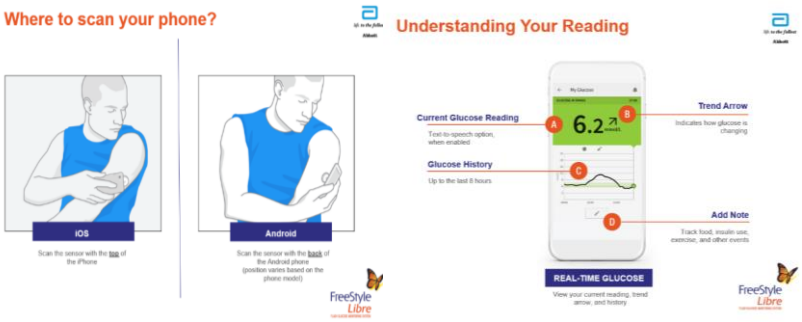
Arrow Trends
Abbott Libre
↑ rising quickly > 0.1 mmol/L per minute (more than 1.5 mmol/L in 15 minutes)
↗ rising 0.06 - 0.1 mmol/L per minute (between 1 - 1.5 mmol/L in 15 minutes)
→ changing slowly < 0.06 mmol/L per minute (less than 1 mmol/L in 15 minutes)
↘ falling 0.06 - 0.1 mmol/L per minute (between 1 - 1.5 mmol/L in 15 minutes)
↓ falling quickly > 0.1 mmol/L per minute (more than 1.5 mmol/L in 15 minutes)

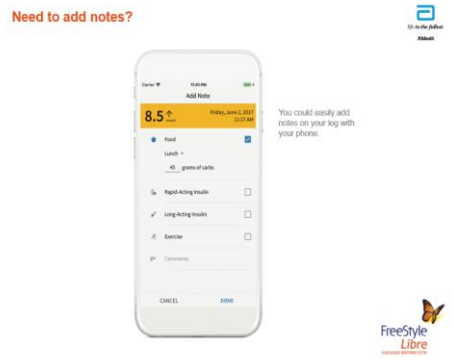
Reference: Abbott (2016). User manual of Freestyle Libre Flash blood glucose monitoring system.

FreeStyle LibreLink App

Features

1) View your current glucose reading, a trend arrow, which indicates how your glucose is changing, and the last 8-hours of glucose history
2) See glucose reports, including your Ambulatory Glucose Profile, which reveal trends and patterns
3) Add notes to track your food, insulin use, exercise, and other events
4) Connect to healthcare professionals and caregivers with LibreView and LibreLinkUp[3]





Home Screen

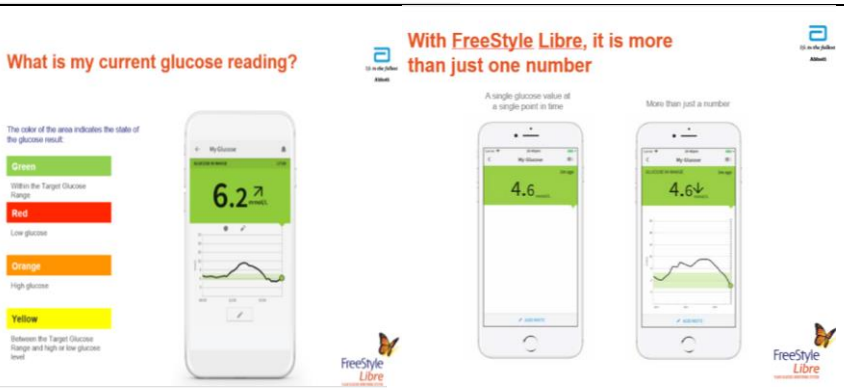
Color indication of sensor glucose level

Green - Within the target glucose range

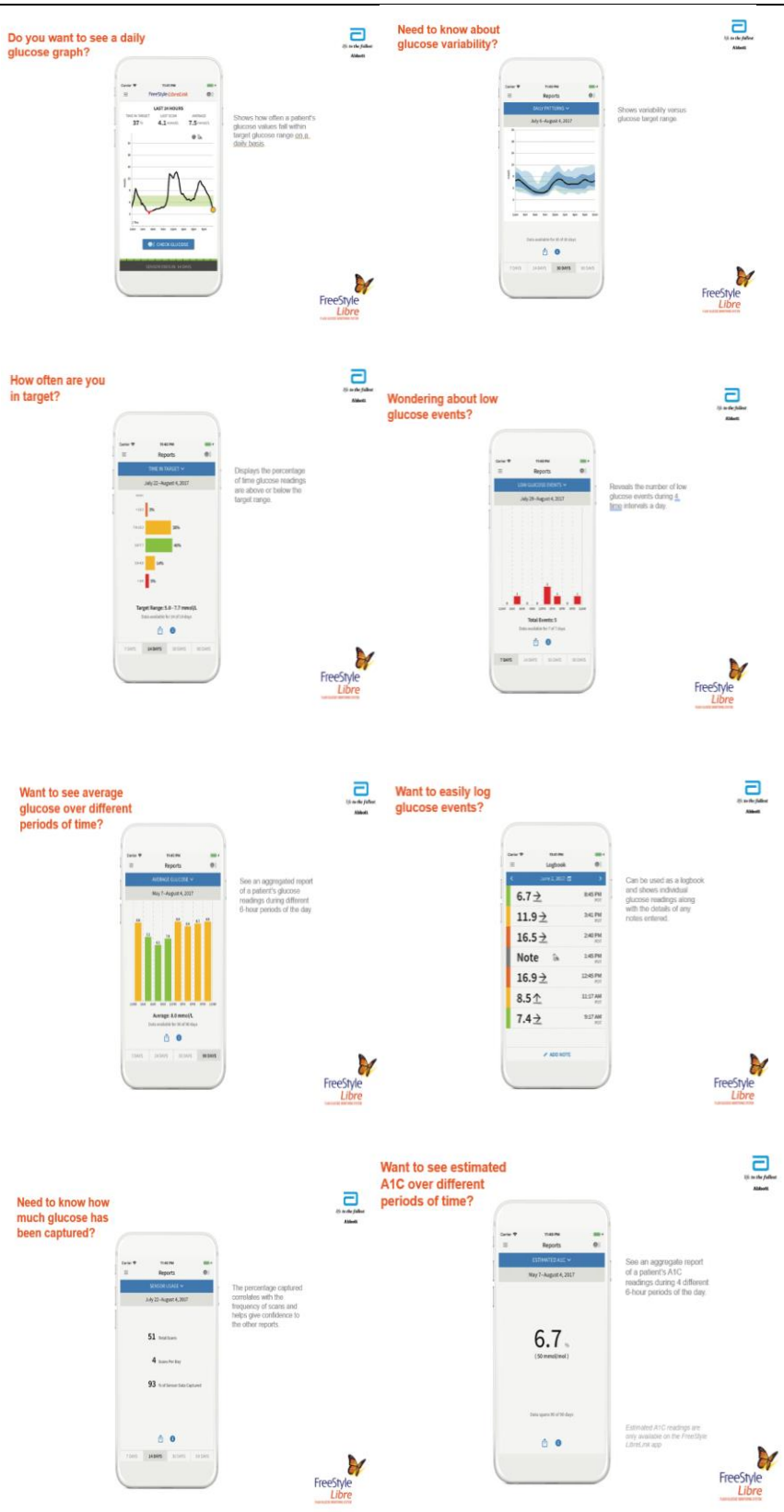
Red - Low glucose

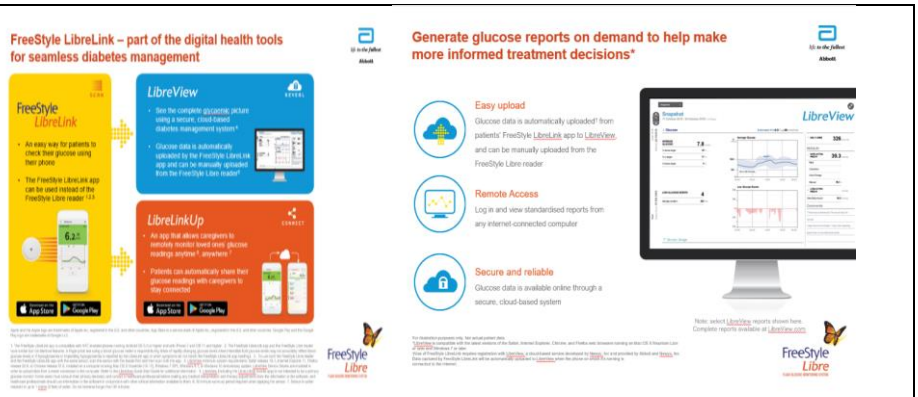
Orange - High glucose

Yellow – Between the target glucose range and high or low glucose level





Operation Introduction	

Cloud-based diabetes management system	

Reference: FreeStyle Librelink User Guide ©2022 Abbott

有關 FreeStyle Libre 使用者信息



感應器佩戴時間	14 天
感應器植入部位	1) 僅在上臂背面植入感應器。避免有疤痕、痣、妊娠紋或腫塊的區域 2）選擇在日常活動中通常保持平坦，無彎曲或折疊的皮膚區域。選擇距離胰島素注射部位至少 2.5 厘米（1 英寸）的部位。為防止不適或皮膚刺激，應轉換植入位置，避免經常重複同一區域 
校對	無需校對 在以下情況，仍然需要進行血糖測試： 1）當血糖水平快速變化（如↑或↓箭頭所示），感應器葡萄糖值可能無法準確反映血糖值時 2）如果 FreeStyle Libre 顯示低血糖或即將發生低血糖 3）徵狀與系統讀數不符時 必須至少每 8 小時掃描一次感應器，以確保獲得完整的 24 小時數據
感應器存儲溫度	4°C 至 30°C，相對濕度 10-90%
防水性	感應器防水可達 1 米水深，持續 30 分鐘，可在日常活動中佩戴，包括沐浴和淋浴
接收信號距離	當掃描感應器時，將閱讀器保持在感應器上方 1 至 4 厘米處，持續 1 秒鐘
附加功能 / 特性	1）閱讀器內置血糖和血酮測試的儀表，以及用於速效胰島素的胰島素計算器 2）閱讀器可重複使用，並且具有可充電電池，必須每 7 天充電一次 3）如果受到航空管制，請勿在飛行時掃描感應器或打開閱讀器電源，需插入試紙進行血糖或酮測試 4）閱讀器只供個人使用。基於傳播感染的風險，不得多人使用包括其他家庭成員在內
注意事項	1) 必須在 X 射線/電腦斷層掃描/磁力共振/其他高磁場或離子放射線程序之前移除感應器 2) 服用抗壞血酸（維生素 C）- 葡萄糖讀數錯誤高 /水楊酸 - 葡萄糖讀數略低
準確性	首 24 小時感應器葡萄糖讀數有偏低情況

可根據感應器葡萄糖值作出治療決定（胰島素劑量調整）	否

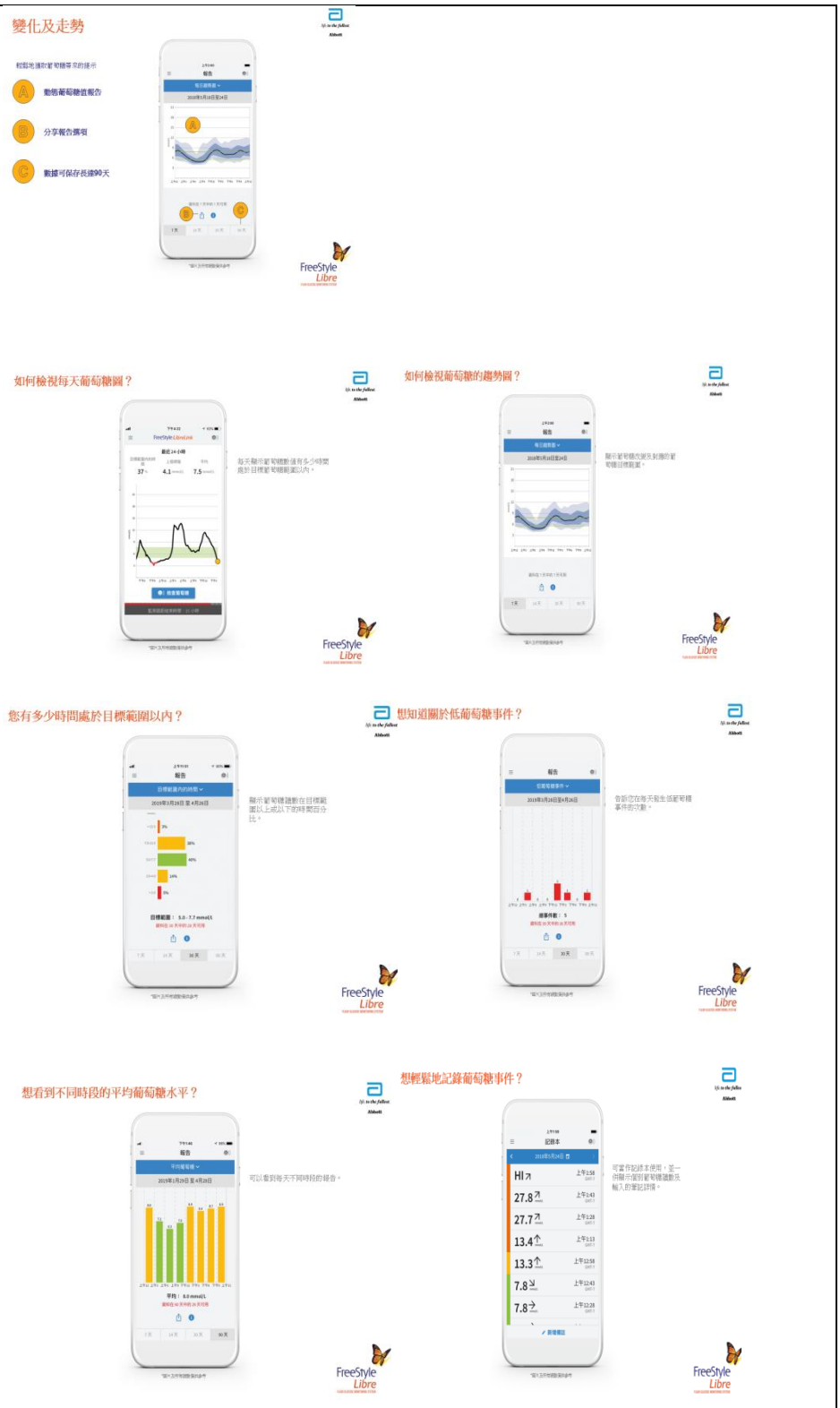
葡萄糖走勢箭頭
Abbott Libre
↑葡萄糖急促上升每分鐘超過 0.1 mmol/L (或 15 分鐘內超過 1.5 mmol/L)
↗葡萄糖上升每分鐘 0.06 - 0.1 mmol/L (或 15 分鐘內上升 1- 1.5 mmol/L)
→葡萄糖慢慢轉變每分鐘少於 0.06 mmol/L (或 15 分鐘內少於 1 mmol/L)
↘葡萄糖下降每分鐘 0.06 - 0.1 mmol/L (或 15 分鐘內下降 1- 1.5 mmol/L)
↓葡萄糖急促下降每分鐘超過 0.1 mmol/L (或 15 分鐘內超過 1.5 mmol/L)

Reference: Abbott (2016). User manual of Freestyle Libre Flash blood glucose monitoring system.

FreeStyle LibreLink 手機應用程式

特色 1) 檢視目前的葡萄糖值及走勢箭頭，顯示你的葡萄糖值變化及最近 8 小時的紀錄。 2) 檢視葡萄糖值報告，包括動態葡萄糖值 (Ambulatory Glucose Profile)反映升跌及趨勢。 3) 加入記錄本紀錄你的飲食、胰島素注射、運動及其他活動事項。 4) 透過 LibreView 及 LibreLinkUp[3] 與你的醫護人員及照顧者聯繫。	
主畫面 顏色提示葡萄糖水平 綠色 – 在目標葡萄糖範圍以內 血色 – 低葡萄糖 橙色 – 高葡萄糖 黃色 – 處於「目標葡萄糖範圍」及「高葡萄糖」或「低葡萄糖」的水平之間	

操作簡介	


變化及走勢
A 動態葡萄糖值報告
B 分享報告選項
C 數據可保存長達90天
如何檢視每天葡萄糖圖？
如何檢視葡萄糖的趨勢圖？
您有多少時間處於目標範圍以內？
想知道關於低葡萄糖事件？
想看到不同時段的平均葡萄糖水平？
想輕鬆地記錄葡萄糖事件？
FreeStyle Libre

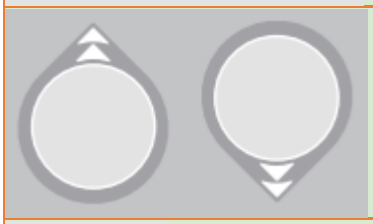
	
雲端糖尿病管理系統	

Reference: Abbott (2022). FreeStyle Librelink User Guide

Patient Information on Using Dexcom G6



Sensor Duration	10 days
Sensor Insertion Site	Adult : belly/back of upper arms Age between 2 and 17 : belly/back of upper arms /upper buttocks **Sensor insertion site should be: - Ensured adequate amount of subcutaneous fat - At least 8 cm from insulin pump infusion set or injection site - Away from waistband, scarring, tattoos, irritation, and bones - Unlikely to be bumped, pushed, or laid on while sleeping
Calibration	No Fingerstick Calibrations required
Confirmation with finger prick blood glucose if hypoglycemia	The Dexcom G6 System is intended to replace fingerstick blood glucose (BG) testing for treatment decisions. (Interpretation of results should be based on the glucose trends and several sequential readings over time. If G6 readings do not match the symptoms, use fingerstick BG value from a glucose meter to make diabetes treatment decisions.)
Sensor storage	2 °C - 30 °C
Waterproof/ Water Resistant	Ingress Protection (IP28): measures how well a device is protected from both solid objects and liquids. You could swim, shower and take a bath with Dexcom G6.
Receiver Distance	The communication range is 6 meters, unobstructed, between the G6 transmitter and paired display device, at regular 5-minute intervals. In water, the range is less than 6 meters. **If the connection is lost between the transmitter and display device, upon reconnection, any missed packets (up to 3 hours) will be transmitted from the transmitter to the display device
Additional Feature	Dexcom G6 system communicate with compatible smart devices through bluetooth and Dexcom G6 App
Precaution	1) Do not wear your CGM (sensor, transmitter, receiver, or smart device) for MRI, CT scan, or diathermy treatment. The magnetic fields and heat could damage the components of the G6, which may cause it to display inaccurate G6 sensor glucose readings or may prevent alerts. 2) Taking hydroxyurea may falsely elevate the G6 readings and result in missed hypoglycemia alerts or errors in diabetes management decisions.
Approved for insulin adjustment without finger prick	Yes

Dexcom Trend Arrows		
	**Steady**	**Changing up to :** - **0.06 mmol/L each minute** - **1.8 mmol/L in 30 minutes**
	**Slowly rising or falling**	**Changing:** - **Between 0.06-0.1 mmol/L each minute** - **Up to 3.4 mmol/L in 30 minutes**
	**Rising or falling**	**Changing:** - **Between 0.1-0.2 mmol/L each minute** - **Up to 5 mmol/L in 30 minutes**
	**Rapidly rising or falling**	**Changing more than:** - **0.2 mmol/L each minute** - **5 mmol/L in 30 minutes**
	**No arrow**	**Cannot determine trend**

Dexcom Clarity Mobile App

Features

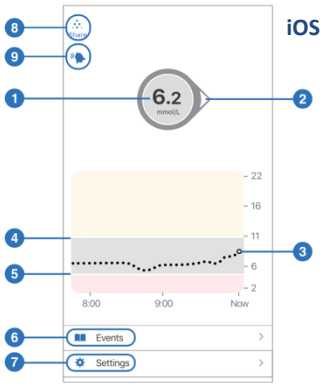
1. **Track your glucose** right on your smartphone
2. **Customized** and **personalized** your high and low alerts
3. **Urgent low** alert at 3.1mmol/dl
4. **Urgent low alert soon** at 3.1mmol/dl **within 20 minutes**
5. **No calibration**
6. Share your glucose data with up to **5 care partners**



Home Screen

Color indication of sensor glucose level

Yellow – High level
Gray – Normal level
Pink – low level

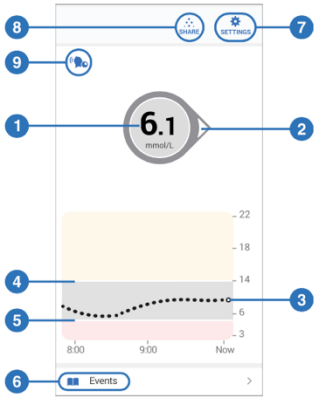


iOS

Number and Arrow
1. G6 Reading
2. Trend Arrow

Graph
3. Current G6 Reading
4. High Alert Level
5. Low Alert Level

Navigation and Status
6. Events ← Add events: carbs, insulin, exercise and health related event
7. Settings
8. Share
9. Always Sound status

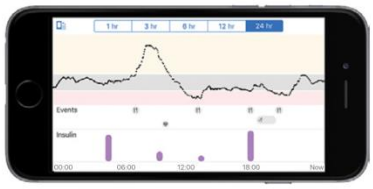


Android

Number and Arrow
1. G6 Reading
2. Trend Arrow

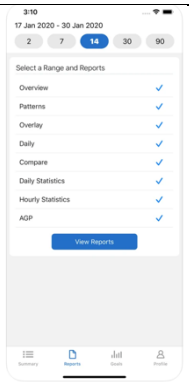
Graph
3. Current G6 Reading
4. High Alert Level
5. Low Alert Level

Navigation and Status
6. Events ← Add events: carbs, insulin, exercise and health related event
7. Settings
8. Share
9. Always Sound status



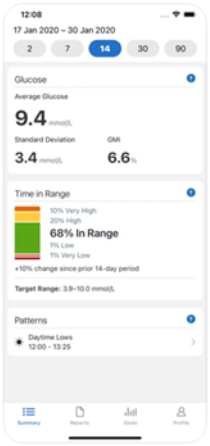
Can choose the display of glucose tracing on 1/3/6/12/24 hours

Report Set up



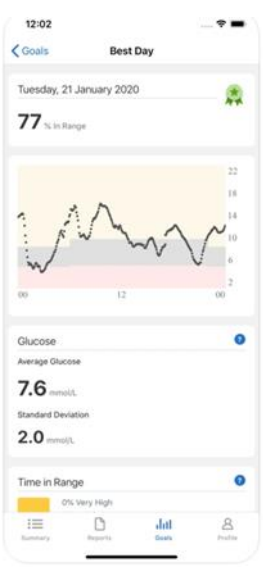
Time In Range
2/7/14/30/90 days

Very high > 13.9 mmol/L	<5%
High 10.1 – 13.9 mmol/L	<25%
Target 3.9 – 10.0 mmol/L	>70%
Low 3.0 – 3.8 mmol/L	<4%
Very Low < 3.0mmol/L	<1%

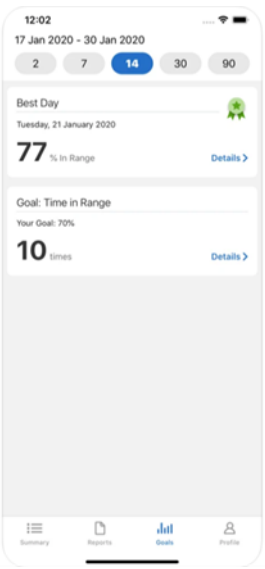




Best Day in a period of time
2/7/14/30/90 days



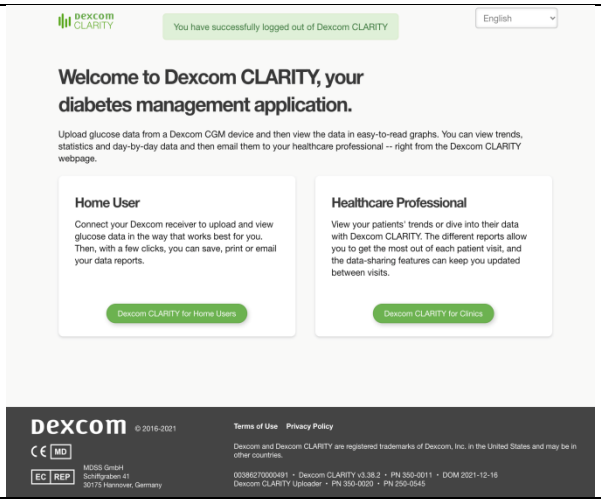




Dexcom CLARITY Personal Account (same username and password with clarity mobile apps)

https://clarity.dexcom.eu/



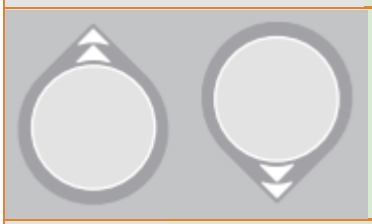


Reference: Dexcom (2019). User's Guide Dexcom G6®.

有關 Dexcom G6 的使用者信息



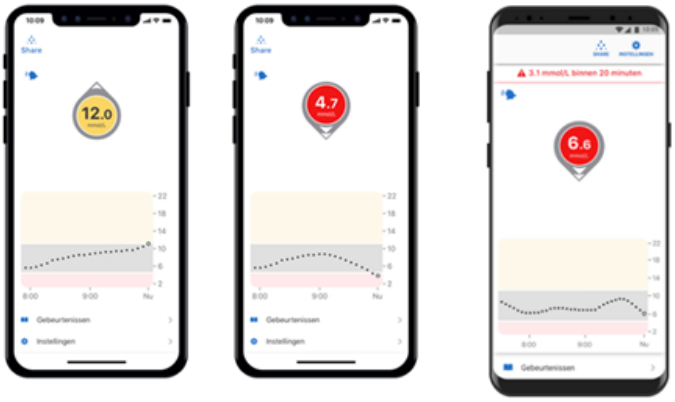
感應器佩戴時間	10 天
感應器植入部位	成人：腹部/上臂後方 2-17 歲：腹部/上臂後方/上臀部 **傳感器插入位置應： – 確保有足夠的皮下脂肪 – 距離胰島素注射部位至少 8 cm – 遠離腰帶、疤痕、紋身、敏感和骨頭部位 - 睡覺時不會被撞到、推到或躺睡時壓著
校對	無需進行血糖校對
如低血糖，需用血糖機確認	Dexcom G6 系統用於代替指尖血糖測試，以作出治療/處理方案的決定。 （對結果的詮釋應基於葡萄糖趨勢和隨時間推移的多個讀數。如果 G6 讀數與症狀不符，請使用血糖儀的指尖 BG 值來做出糖尿病治療/處理方案的決定。）
感應器存儲溫度	2 ℃ - 30 ℃
防水性	國際防水標準 IP28:儀器達到認可標準抵擋固體和液體入侵。游泳、淋浴和浸浴時可以使用 Dexcom G6。
接收信號距離	G6 發射器與已配對的顯示裝置之間的通訊距離為 6 米(沒有障礙物)，間隔為每 5 分鐘。 在水中，通訊距離為少於 6 米。 **如果發射器和已配對的顯示裝置之間的連接丟失，最長 3 小時丟失的數據會於重新連接後從發送器發傳送到顯示裝置。
附加功能 / 特性	Dexcom G6 系統通過藍牙及 Dexcom G6 程式與兼容的智能設備進行通信。
注意事項	1. 請勿佩戴 CGM（傳感器，發射器，接收器或智能設備）進行磁力共振，電腦掃描或透熱療法。 磁場和熱量可能會損壞 G6 的組件，這可能會導致 G6 傳感器葡萄糖讀數顯示不准確，或者會無法警報。 2. 服用羥基脲可能會錯誤地令 G6 的讀數升高，並導致錯失低血糖警報或引致糖尿病處理決策錯誤。
可根據感應器葡萄糖值作出治療決定（胰島素劑量調整）	是

Dexcom 葡萄糖走勢箭頭		
	穩定	改變達至 : - 每分鐘 0.06 mmol/L - 30 分鐘內 1.8 mmol/L
	緩慢上升或下降	改變: - 每分鐘介乎 0.06-0.1 mmol/L - 30 分鐘內達至 3.4 mmol/L
	上升或下降	改變: - 每分鐘介乎 0.1-0.2 mmol/L - 30 分鐘內達至 5 mmol/L
	快速上升或下降	改變多於: - 每分鐘 0.2 mmol/L - 30 分鐘內 5 mmol/L
	沒有箭頭	無法確定趨勢

Dexcom Clarity 手機應用程式

特色

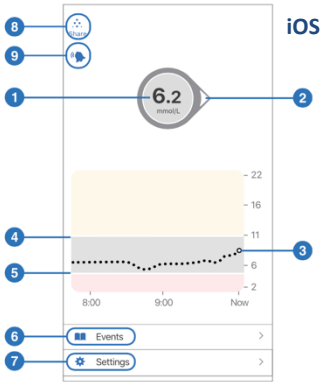
1. 在手機上追蹤你的葡萄糖值
2. 個人化製定高低葡萄糖提示
3. 於 3.1mmol/L 收到緊急低葡萄糖提示
4. 緊急低葡萄糖預示 20 分鐘內低至 3.1mmol/L
5. 不需校準
6. 與 5 位照顧者分享你的葡萄糖資訊



主畫面

顏色提示葡萄糖水平

黃色 – 高
灰色 – 正常
粉紅色 – 低



iOS

讀數及箭咀

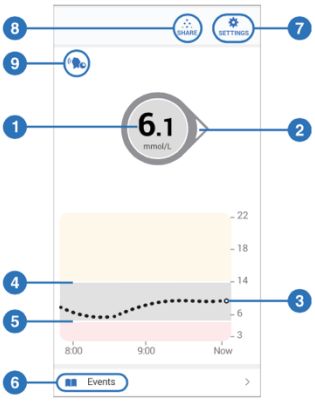
1. **葡萄糖值**
2. **箭咀方向**

圖像

3. **目前葡萄糖值位置**
4. **高提示水平**
5. **低提示水平**

導航及狀況

6. **事件薄 – 碳水化合物份量，胰島素，運動等**
7. **設定**
8. **分享**
9. **鈴聲設定顯示**



Android

讀數及箭咀

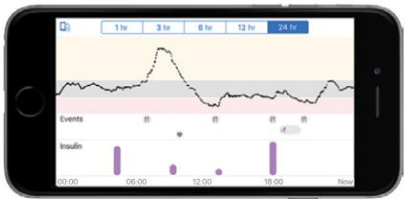
10. **葡萄糖值**
11. **箭咀方向**

圖像

12. **目前葡萄糖值位置**
13. **高提示水平**
14. **低提示水平**

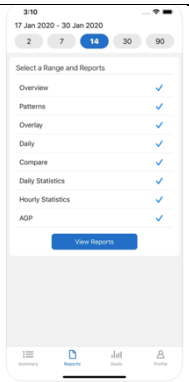
導航及狀況

15. **事件薄 – 碳水化合物份量，胰島素，運動等**
16. **設定**
17. **分享**
18. **鈴聲設定顯示**



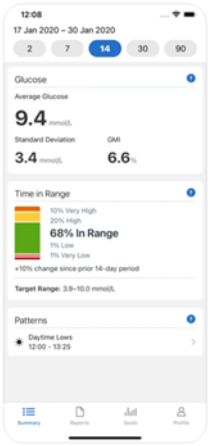
Can choose the display of glucose tracing on 1/3/6/12/24 hours

報告設



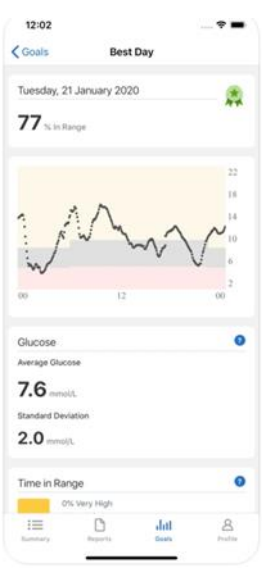
葡萄糖值時間範圍
2/7/14/30/90 日

非常高> 13.9 mmol/L	<5%
高 10.1 – 13.9 mmol/L	<25%
目標 3.9 – 10.0 mmol/L	>70%
低 3.0 – 3.8 mmol/L	<4%
非常低 < 3.0mmol/L	<1%

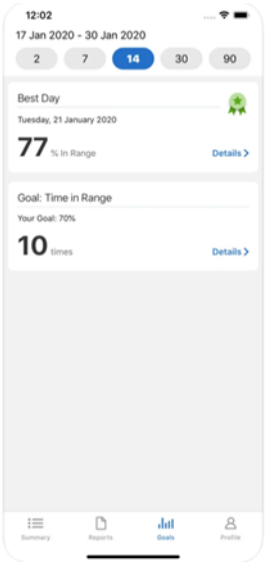




特定時段內最佳的一日
2/7/14/30/90 日







Dexcom CLARITY 個人帳户（用户名稱及密碼與 CLARITY 手機流動應用程式相同） https://clarity.dexcom.eu/ 	

Reference: Dexcom (2019). User's Guide Dexcom G6®.

Patient Information on Using Guardian Connect



Sensor Duration	7 days
Sensor Insertion Site	Adult – abdomen or upper arm (ensure adequate amount of subcutaneous fat) Age between 14 and 75 Insulin injection should be at least 7.5 cm (3 inches) away from sensor site.
Calibration	Calibrate within 2 hours after insertion, then calibrate within 6 hours after first calibration. Subsequent Calibration required every 12 hours at any rate of change.
Confirmation with finger prick blood glucose if hypoglycemia	Yes
Sensor storage	2 °C -27 °C
Waterproof/ Water Resistant	After the transmitter and sensor are connected, they form a waterproof seal to a depth of 2.4 meters (8 feet) for up to 30 minutes.
Receiver Distance	Decrease the distance between the transmitter and the compatible mobile device to 6.1 meters (20 feet) or less
Additional Feature	1. Mobile communication through blue-tooth and Apps 2. Predicted high and low alert within 10-60 minutes 3. Share 24-hour real time data with maximum 5 care partners 4. Receive SMS alert
Precaution	1) Do not bring the sensor and transmitter into a room containing medical equipment such as X-Ray, MRI, CT, or diathermy. Exposure to these types of equipment could heat and damage sensor and transmitter, so that they are unable to send or receive glucose information. 2) Taking medications with paracetamol/acetaminophen/ Hydroxyurea while wearing the sensor may falsely raise sensor glucose readings. 3) If the transmitter is not in use, you must charge the transmitter at least once every 60 days. Do not store the transmitter on the charger.-If the transmitter is left on the charger for more than 60 days, the battery will be permanently damaged.
Approved for insulin adjustment without finger prick	No

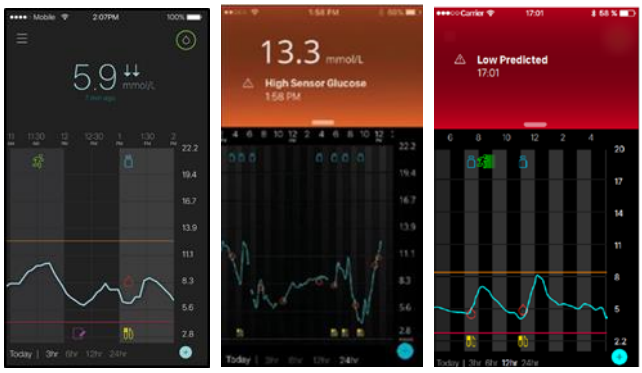
Arrows Trends
Guardian Connect
↑↑↑ Rapidly rising more than 0.17 mmol/L each minute (or more than 2.5 mmol/L in 15 minutes)
↑↑ Rising 0.11-0.16 mmol/L each minute (or up to 2.5 mmol/L in 15 minutes)
↑ Slowly rising 0.06-0.11 mmol/L each minute (or up to 1.67 mmol/L in 15 mintues)
↓ Slowly falling 0.06-0.11 mmol/L each minute (or up to 1.67 mmol/L in 15 mintues)
↓↓ falling 0.11-0.16 mmol/L each minute (or up to 2.5 mmol/L in 15 minutes)
↓↓↓ Rapidly falling more than 0.17 mmol/L each minute (or more than 2.5 mmol/L in 15 minutes)

Guardian Connect Mobile Apps

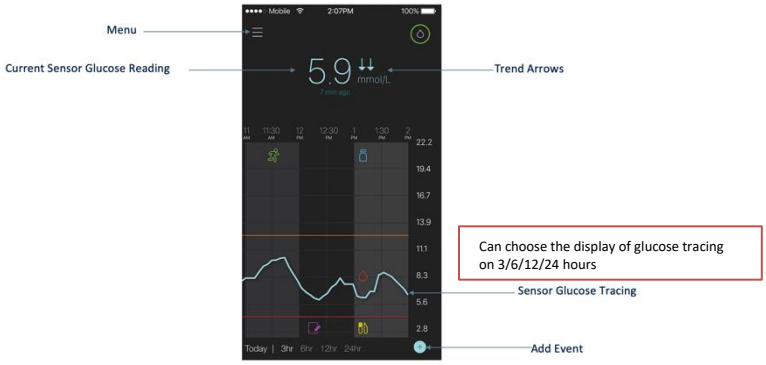
Features

1. **Track your glucose** right on your smartphone
2. **Customized** and **personalized** your high and low alerts
3. **Urgent low** alert at 3.1mmol/dl
4. **Predictive alert 10-60 minutes** in advance of a high or low event

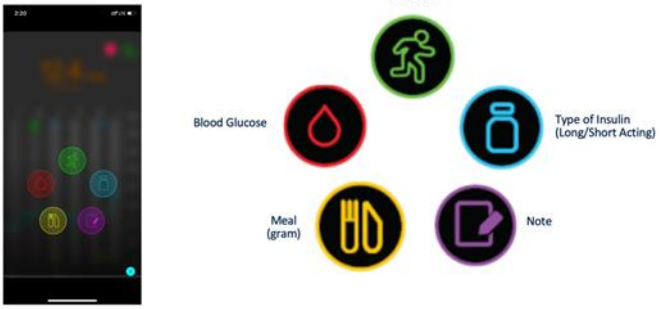
Share your glucose data with up to **5 care partners**



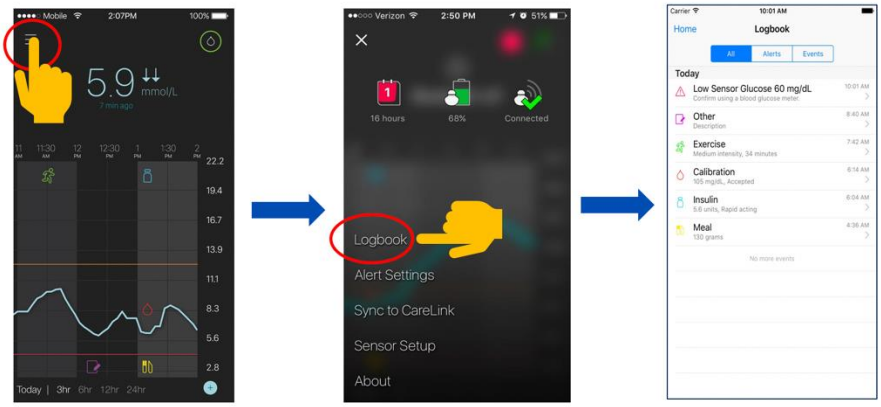
Home Screen

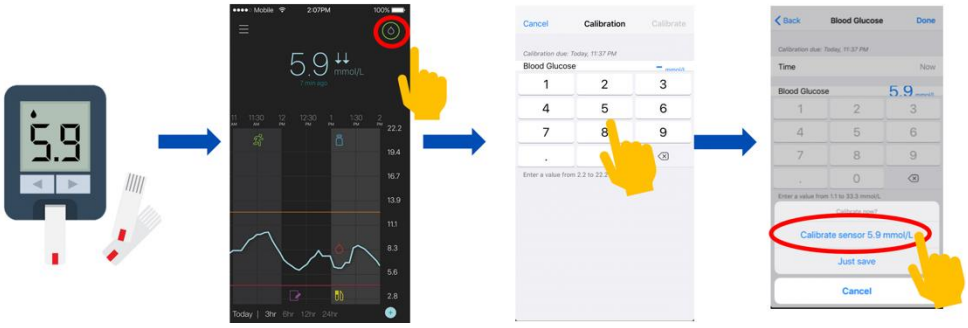
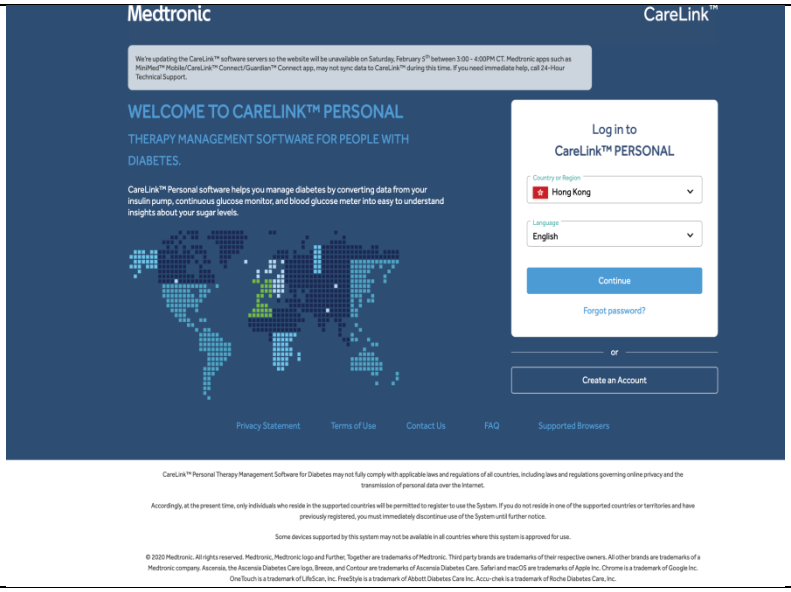


Event Markers



Menu > Logbook



Calibration	
Medtronic – Guardian Connect Personal account (same username and password with Guardian Connect mobile apps) https://carelink.minimed.com/app/login	

Reference: Guardian Connect CGM System User Guide @ Medtronic

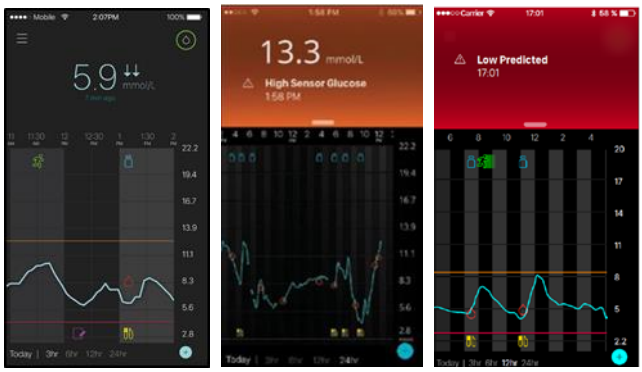
有關 Guardian Connect 的使用者信息

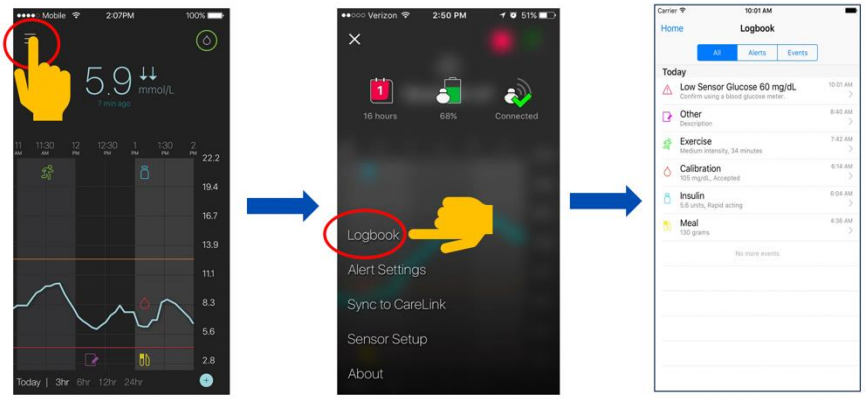
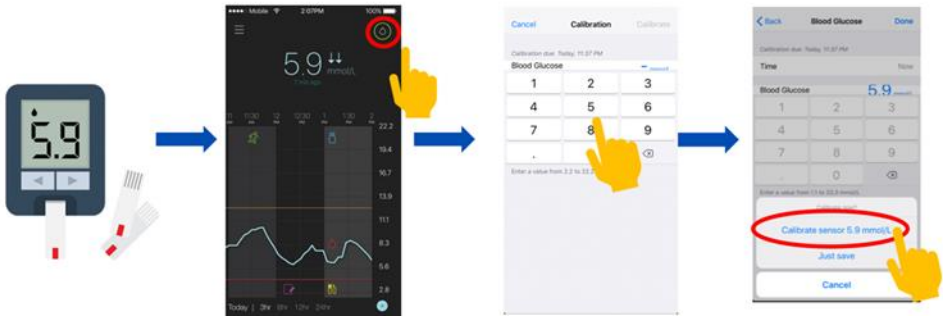
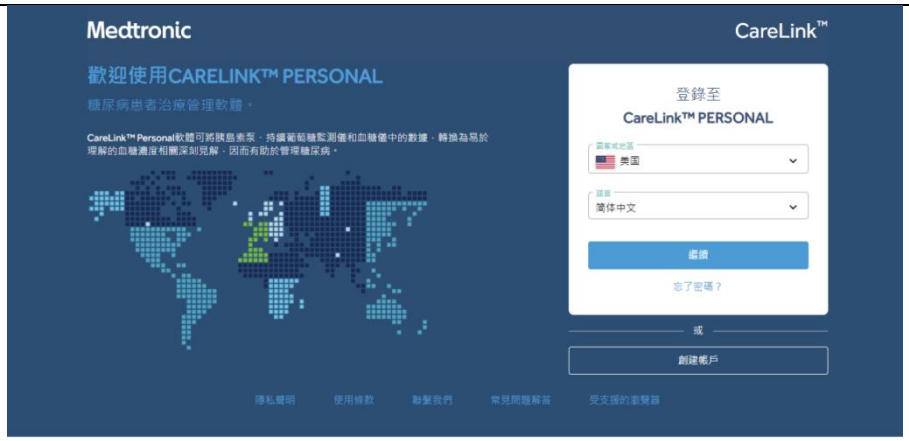


感應器佩戴時間	7 天
感應器植入部位	成人 – 腹部或上臂（確保足夠皮下脂肪量） 14 到 75 歲之間 胰島素注射應距感應器部位至少 7.5 厘米（3 英寸）。
校對	進行血糖測試並輸入讀數作校對 1）第一天： ・植入後至少 2 小時進行 ・植入後至少 6 小時進行 2）其後每 12 小時必須校對一次
如低血糖，需用血糖機確認	是
感應器存儲溫度	2°C -27°C
防水性	連接發射器和感應器後，它們將形成防水密封，防水深度達 2.4 米（8 英尺），持續 30 分鐘
接收信號距離	發射器和兼容流動設備之間的距離為 6.1 米 (20 英尺)或更短
附加功能 / 特性	1）通過藍芽和 Apps 進行通信 2）在 10-60 分鐘內發出預測高低警報 3）與最多 5 個照顧者共享 24 小時實時數據 4） 接收短信提醒
注意事項	1）請勿將感應器和發射器帶入具有X光，磁力共振，電腦掃描或透熱療法等醫療設備的房間。 暴露於這類型設備會加熱和損壞感應器和發射器，令他們無法發送或接收葡萄糖值信息 2）佩戴感應器時服用含乙酰氨基酚或撲熱息痛的藥物可能會錯誤地提高感應器葡萄糖讀數 3）如果不使用發送器，則必須至少60天對發送器充電一次。不要在充電器上存放發送器。如果發送器連在充電器上超過60天，電池將永久損壞。
可根據傳感器葡萄糖值作出治療決定（胰島素劑量調整）	否

葡萄糖走勢箭頭
Guardian Connect
↑ ↑ ↑每分鐘快速上升超過 0.17 mmol/L （或 15 分鐘內超過 2.5 mmol/L）
↑ ↑每分鐘上升 0.11-0.16 mmol/L （或 15 分鐘內上升至 2.5 mmol/L）
↑每分鐘緩慢上升 0.06-0.11 mmol/L （或 15 分鐘內上升至 1.67 mmol/L）
↓每分鐘緩慢下降 0.06-0.11 mmol/L （或 15 分鐘內最高可達 1.67 mmol/L）
↓ ↓每分鐘下降 0.11-0.16 mmol/L （或 15 分鐘內下降至 2.5 mmol/L）
↓ ↓ ↓每分鐘快速下降超過 0.17 mmol/L （或 15 分鐘內超過 2.5 mmol/L）

Guardian Connect 手機應用程式

特色 1. 在手機上追蹤你的葡萄糖值 2. 個人化製定高低葡萄糖提示 3. 於 3.1mmol/dl 收到緊急低葡萄糖提示 4. 可於 10-60 分鐘前收到高或低的葡萄糖預測提示 5. 與 5 位照顧者分享你的葡萄糖資訊	
主畫面	
事件標記	 

主菜單> 日誌	
校準感應器	
Medtronic – Guardian Connect 個人帳戶 （用户名稱及密碼與 Guardian Connect 手機流動應用程式相同）	

Reference: Guardian Connect CGM System User Guide @ Medtronic

Chapter 6: Interpretation of results

Evidence

CGM provides a lot of useful glucose data to help with diabetes management. There are however several brand-specific software programs and reports from different CGM manufacturers.

In December 2017, a consensus statement for standardized CGM reporting format was published aligning the definition of core CGM metrics, priorities for routine display and use of AGP modal day visualization[1]. Level IVA

One-page AGP summary is available on Libreview, Dexcom Clarity and Medtronic Carelink in Hong Kong. However, as the Medtronic Guardian Connect sensor only lasts for 7 days, its AGP report cannot provide glycaemic management indicator (GMI) and Coefficient of Variability (CV), also there is insufficient data for CGM metrics interpretation, unless the patient uses Guardian Connect sensors continuously to provide sufficient glucose data. Level VA

Dexcom G6 sensor can be used for 10 days, the patient should not disconnect in between days to provide sufficient data for retrospective data analysis. 12-15 day period of CGM monitoring every 3 months may optimally assess overall glucose control[2]. Level IA

As the one page summary of different CGM providers is available in Hong Kong, we recommend the steps of data interpretation based on principles of the consensus statement.

Understanding of CGM metrics

1. Data sufficiency
    - 1.1 14 days of CGM data correlate well with 3 months of CGM data in type 1 diabetes study, particularly for mean glucose, all levels of glucose ranges and coefficient of variation[3]. Level IIIA
    - 1.2 At least 70% data of 14 days or ~10days of CGM wear is required to provide a reliable indicator of usual patterns[1,4] Level IVA

2. Glucose exposure

2.1 Sensor glucose average provides an estimation of the Glucose Management Indicator (GMI, the proposed term to replace eHbA1c) which is derived from CGM-driven mean glucose in 10-14 days by a standard formula — Level VA

2.2 It should be more correlated to laboratory HbA1c if there is no special event or change of anti-diabetic medications[5,6]

2.3 Average glucose and GMI may be higher than laboratory HbA1c during a short period of acute hyperglycemia[5,6]

2.4 Average glucose and GMI may be lower than laboratory HbA1c after starting new carbohydrate-reduced diet, an intensive exercise or during the first few weeks after starting a new effective anti-diabetic medication[5,6]

3. Time in Range (TIR)

3.1 Higher percentage of time in range to indicate better HbA1c[7] — Level VA

3.2 The common default range is 3.9-10 mmol/L[8] [8,9] — Level IIIA

3.3 There is strong correlation between TIR and HbA1c, with a goal of 70% TIR aligning with an HbA1c of 7% in Type 1 and Type 2 Diabetes[10,11] — Level IIIA

Measured TIR (3.9-10mmol/L)	HbA1c(%)
0%	12.1%
10%	11.4%
20%	10.6%
30%	9.8%
40%	9.0%
50%	8.3%
60%	7.5%
70%	6.7%
80%	5.9%
90%	5.1%
100%	4.3%

Vigersky RA, McMahon C. *Diabetes Technol Ther* 2019; 21:81–85.

3.4 Non-pregnant adults Type 1 and Type 2 Diabetes

3.4.1 Target of 70% for time in range (3.9-10 mmol/L) <4% for time below range (<3.9 mmol/L) and <1% time <3 mmol/L[12,13] Level IVA

3.5 Action for hypoglycemia[14] Level VA

3.5.1 <3-3.9 mmol/L : alert and monitor

3.5.2 < 3 mmol/L : clinically significant, immediate action required

3.6 Action for hyperglycemia[14] Level VA

3.6.1 >10-13.9 mmol/L : alert and monitor

3.6.2 > 13.9 mmol/L : clinically significant, immediate action required

3.7 Older/High-Risk Type 1 and Type 2 Diabetes[12] Level IVA

3.7.1 Time in Range (3.9-10 mmol/L) : goal >50%

3.7.2 Time in Hypo (<3.9 mmol/L): goal <1%

3.7.3 Time in Hyper (>10 mmol/L): goal <50%

(<10% of this >13.9mmol/L)

**The primary target for older Type 1 Diabetes with a long duration of diabetes should be Time below range (TBR) less than 1% [13] Level IVA

**Glycaemic targets in older adults are based on functional status and life expectancy, aims to minimize hypoglycemia[15]

3.8 During Pregnancy (Type 1 Diabetes)[12,13]

** Percentage of time in range is based on limited evidence Level IVA

3.8.1 Time in range (3.5–7.8 mmol/L), goal >70%

3.8.2 Time below range (<3.5 mmol/L), goal <4%

3.8.3 Time below range (<3.0 mmol/L), goal <1%

3.8.4 Time above range (>7.8 mmol/L), goal <25%

3.8.5 Target TIR is lower during pregnancy (3.5–7.8 mmol/L)

3.9 During Pregnancy (Gestational & Type 2 Diabetes)[12] Level IVA

** Percentage of time in range has not been established because of very limited evidence

3.9.1 Time in Range (3.5-7.8 mmol/L)

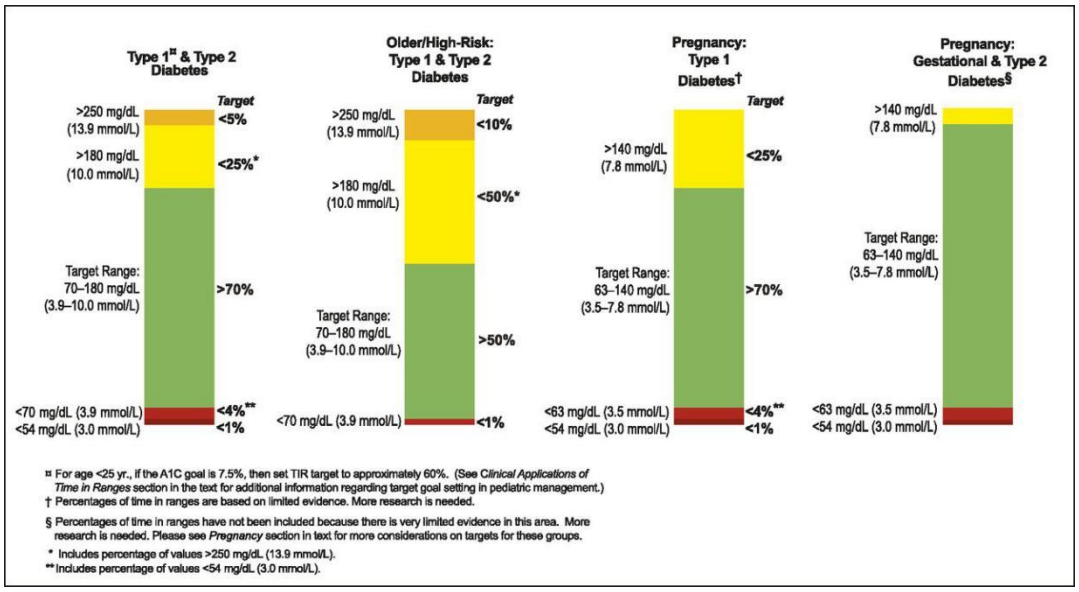
3.9.2 Time below range (<3.5 mmol/L)

3.9.3 Time above range (> 7.8 mmol/L)

3.10 Diabetes in children[10,16] Level IVA

** Percentage of time in range in children has not been established because of very limited evidence

CGM-based targets for different diabetes populations



Battelino T. & Danne T et al. Dia Care 2019;42:1593-1603

3.11 TIR is strongly associated with the risk of microvascular complications and should be an acceptable end point for clinical trial[8]

3.12 TIR is associated with the prevalence of diabetic retinopathy in type 2 diabetes[4] Level IIIA

3.13 There is a good correlation between HbA1c and TIR, therefore TIR can be preferred metric for determining the outcome of clinical studies, predicting the risk of diabetes complications, and assessing individual patient's glycemic control[10] Level IIIA Level IIIA

4 Glycemic Variability (GV)

4.1	Coefficient of variation (CV) : < 36% means stable glucose profile[17]	Level IIIB
4.2	Standard deviation (SD) : <33% of mean sensor glucose value means stable glucose profile[18]	Level VA
4.3	Inter-quartile Range (IQR) : using in AGP – visualize the pattern, the wider cloud between 25^{th}-75^{th} percentile implies greater CV vs ribbon shape between 25^{th}-75^{th} percentile meaning less CV[14]	Level VA

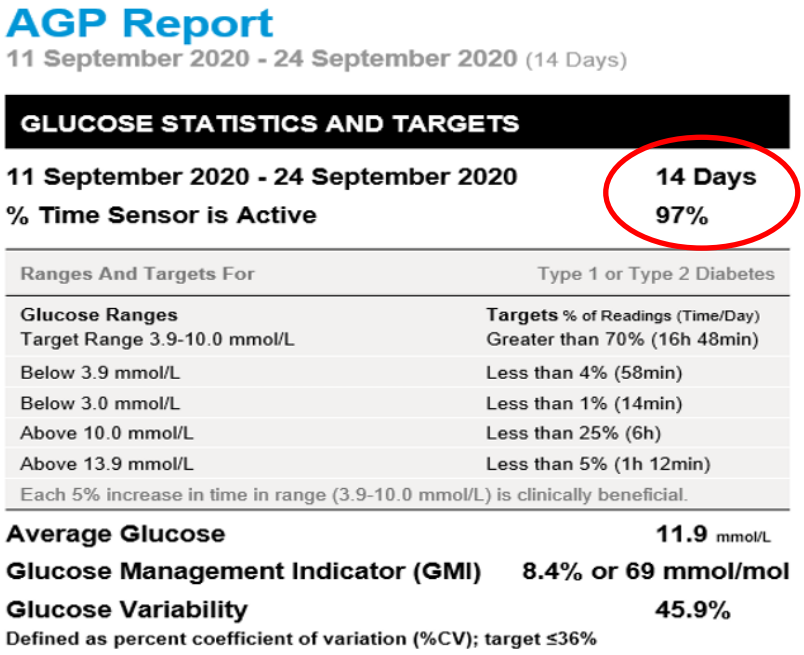
Steps of CGM data interpretation

1. Review the data sufficiency and accuracy[19,20]

1.1 Libre

1.3.1 Duration 14 days — Level IIIB

1.3.2 Data capture > 70% — Level VA



AGP Report

11 September 2020 - 24 September 2020 (14 Days)

GLUCOSE STATISTICS AND TARGETS

11 September 2020 - 24 September 2020	**14 Days**
% Time Sensor is Active	**97%**

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.	

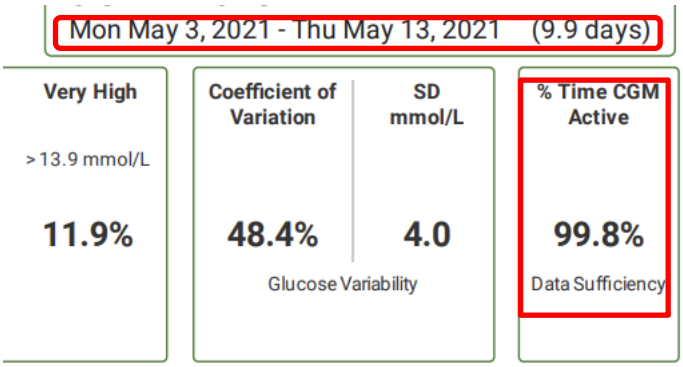
Average Glucose	**11.9** mmol/L
Glucose Management Indicator (GMI)	**8.4% or 69 mmol/mol**
Glucose Variability	**45.9%**

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

1.2 Medtronic

1.3.1 Glycemic management indicator (GMI) and Coefficient of Variation (CV) will not be provided in 7 days report. — Level VB

1.3 Dexcom



Level VB

2 Mark the factors that may affect the management plan in the daily profile sheet[14,20] Level VA

2.1 Age, Type of DM, DM duration, Hx of known CVD, eGFR, weight

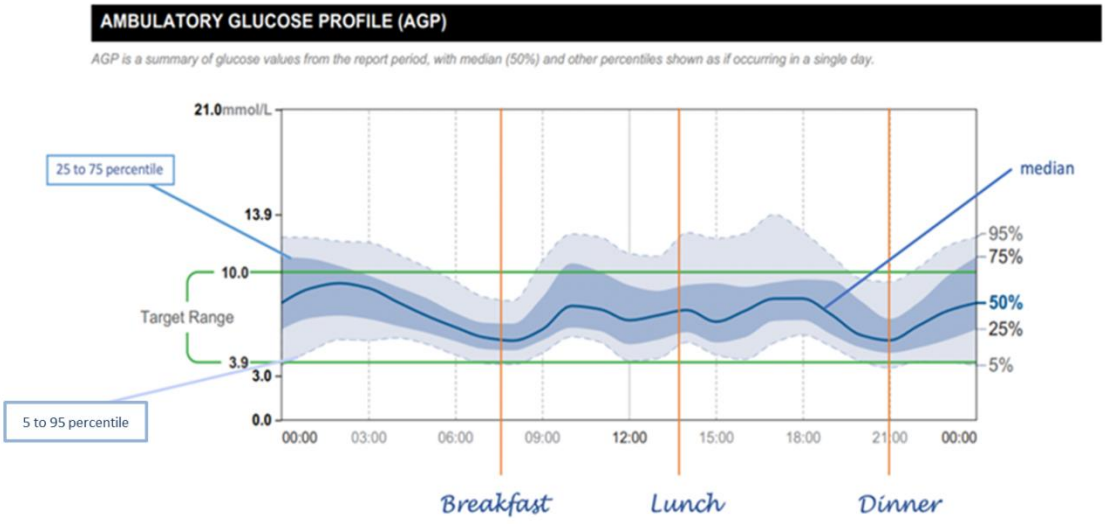
2.2 Current medications (if on insulin, daily dose - units/kg)

2.3 Daily routine including meal-time, snacking, exercise and medications or injection time

3 Ask the patient to express their thoughts on their own profiles and let patients provide honest, helpful insights to explain the glucose pattern[20] Level VA

3.1 Show the marked-up (daily routine and medications) glucose profile pattern such as ambulatory glucose profile (AGP profile)

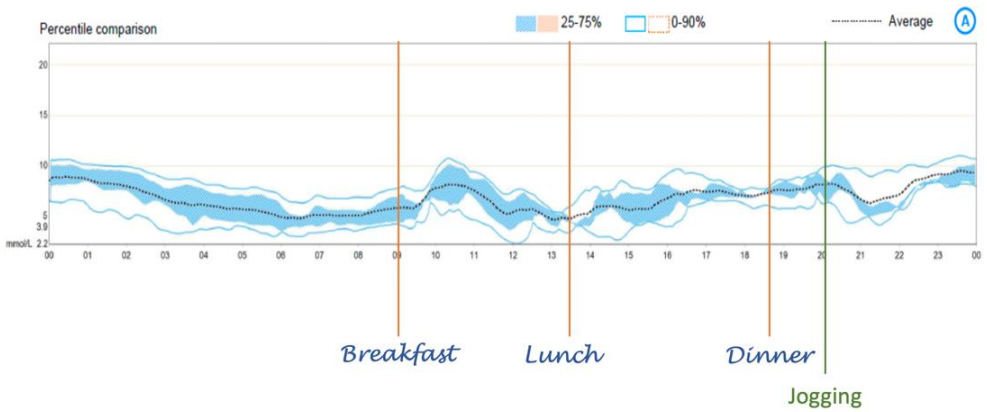
3.1.1 Libre



Type 1 DM since 2012, BMI 23.4, No history of DM complications

Tresiba 14 units om, Novorapid 6 / 7/ 6 units before meals, ICR 8g, ISF 3 mmol/L

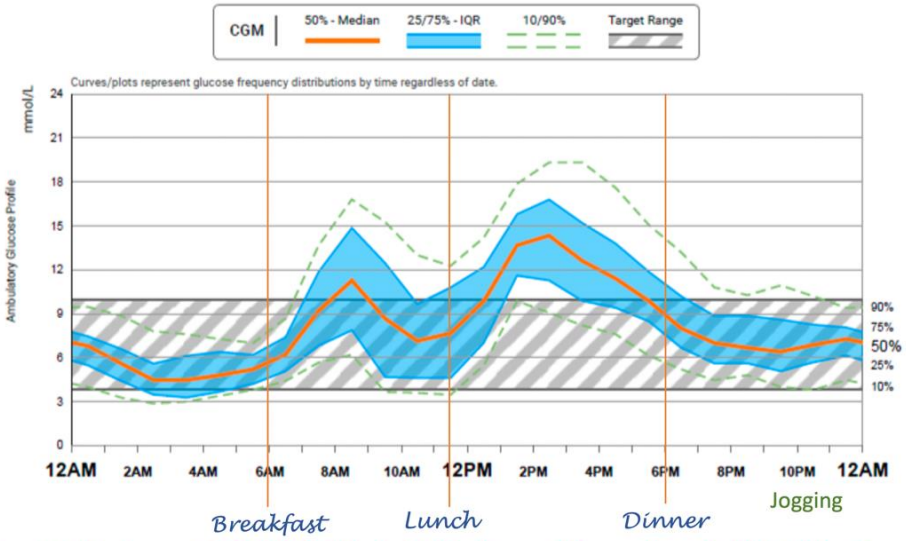
3.1.2 Medtronic



Type 2 DM since 2008, BMI 26.1,history of CVD & PCI done

Lantus 20 units nocte, Diamicron 80mg bd, Metformin 1g bd, Galvus 50mg bd

3.1.3 Dexcom



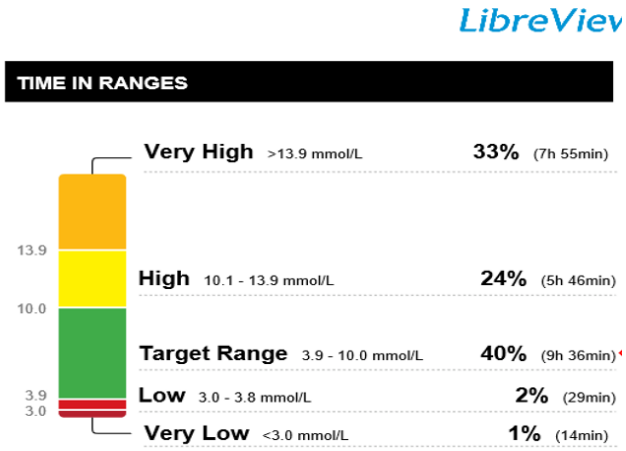
Type 2 DM since 2018, BMI 28.3, DKD stage 3B, moderate NPDR both eyes

Mixtard 30 _ 20units before breakfast and 18 units ac dinner Metformin 500 bd, Galvus 50mg om

3.2 Compare TIR bar chart with reference range with patient's own TIR[20] Level IVA

Very high	<5%
High	<25%
Target	>70%
Low	<4%
Very Low	<1%

3.2.1 Libre sample



3.2.2 Medtronic Sample



3.2.3 Dexcom Sample



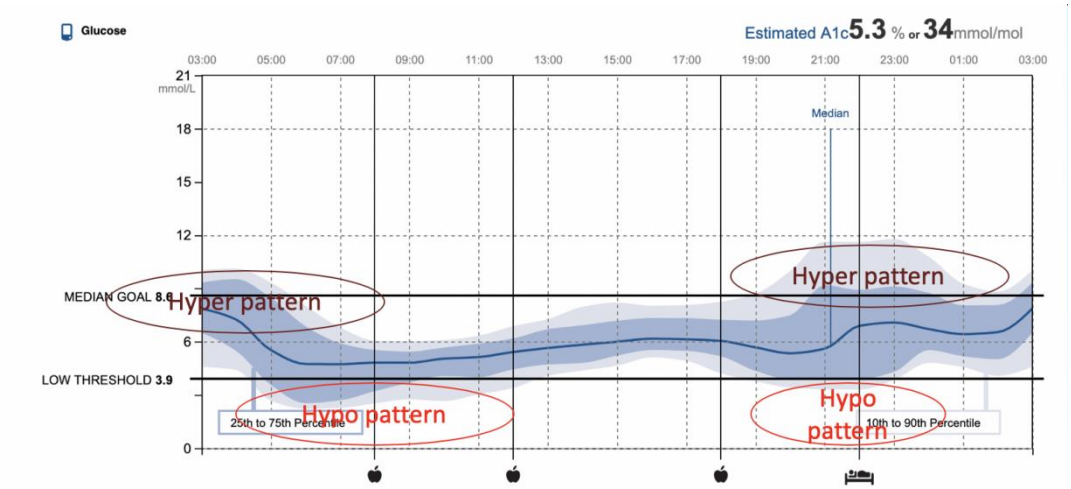
4 Looking for patterns of low glucose level[14] Level VA

- 4.1 Identify midnight hypoglycemia and assess the recurrent episodes or isolated episode
- 4.2 Identify daytime pre and post meals hypoglycemia
- 4.3 Consider 3 – 4 hours after meal as post meal glucose profile
- 4.4 Monitor for weekdays vs weekends hypoglycemia
- 4.5 Obtain patient's information to assess contributors of hypoglycemia
- 4.6 Determine if hypoglycemia is caused by basal insulin dose

5. Looking for pattern of high glucose level[14]

- 5.1 Identify daytime pre and post meal and midnight hyperglycemia
- 5.2 Consider 3 – 4 hours after meal as post meal glucose profile
- 5.3 Monitor for weekdays vs weekend hyperglycemia
- 5.4 Obtain patient's information to assess contributors of hyperglycemia
- 5.5 Determine if hyperglycemia is caused by basal insulin dose

5.5.1 Libre sample



Considerations for the Clinician[1]

Most Important Pattern: Lows Overnight, Afternoon

Medication

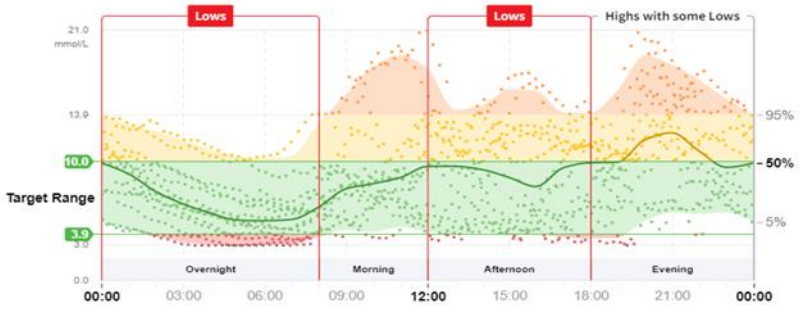
- Medications contributing to lows?
- Medication added to address highs may worsen lows

Lifestyle

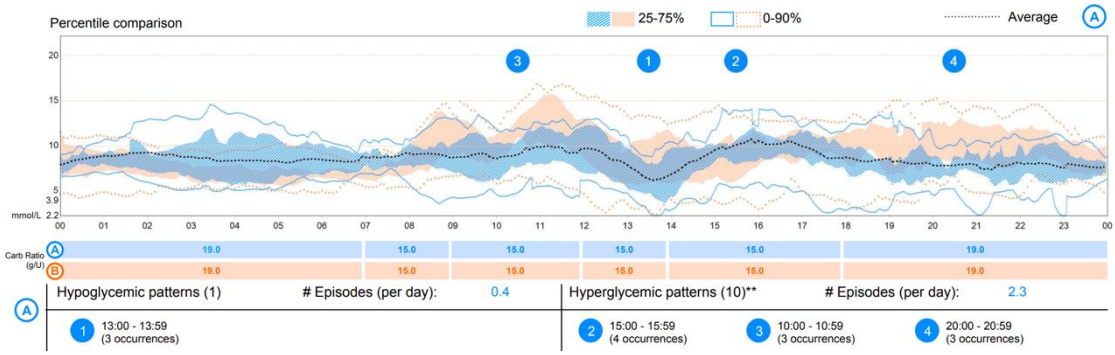
Lows are often associated with high glucose variability. The following behaviors may contribute to glucose variability:

- Meals sometimes missed or vary in carbohydrates?
- Activity level varies daily?
- Alcohol consumption varies daily?

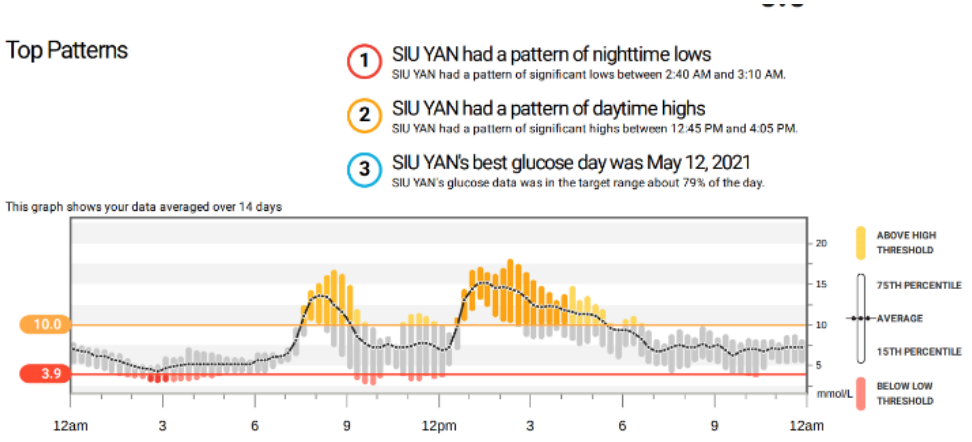
Glucose Patterns (14 Days)

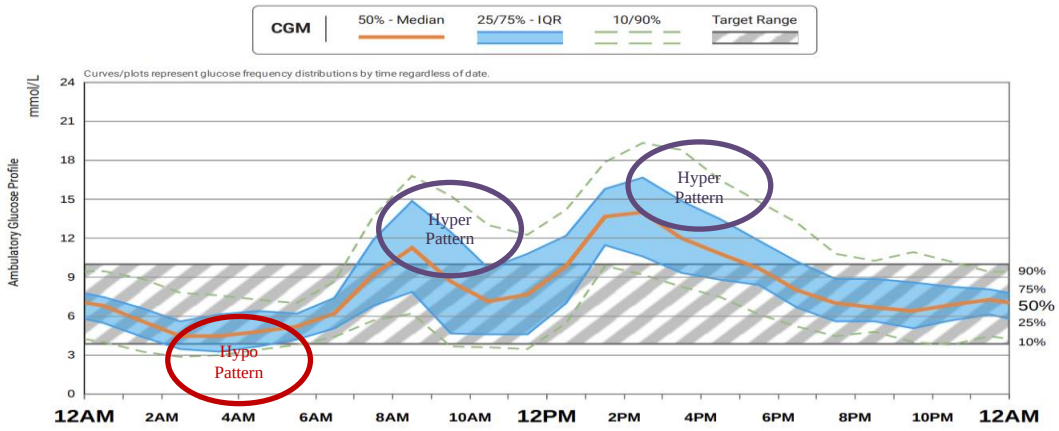


5.5.2 Medtronic sample



5.5.3 Dexcom Sample





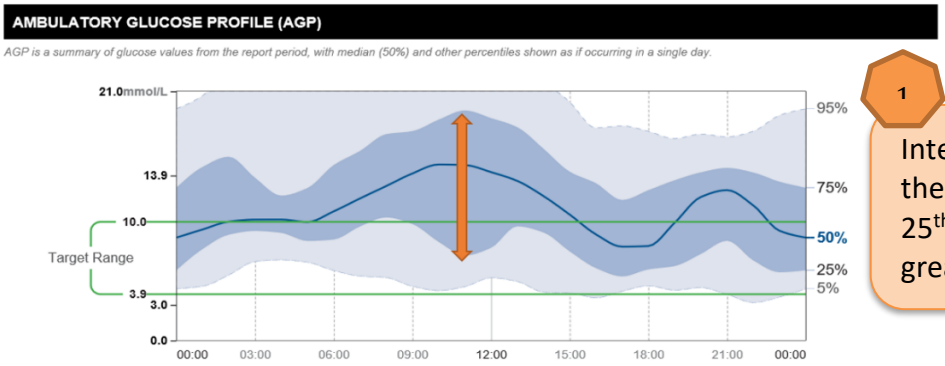
6. Look for areas of wide glucose variability[14] (high GV)

6.1 Aim to minimize the high GV by adjusting the timing or amount Level VA

6.1.1 Timing: insulin and meals, weekday and weekend, snacks, exercise, stress

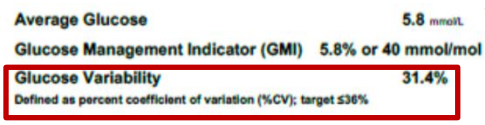
6.1.2 Amount: insulin (daily dose or carb counting), insulin to carb ratio, exercise intensity.

6.1.2.1 Libre sample



1

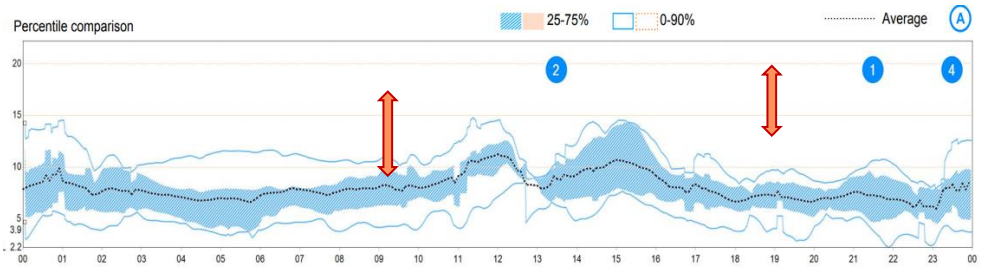
Inter-quartile Range (IQR) : the wider cloud between 25th-75th percentile means great CV

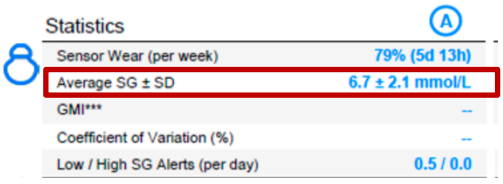


2

Coefficient of Variation
If %CV > 36% = High variability[9]

6.1.2.2 Medtronic sample

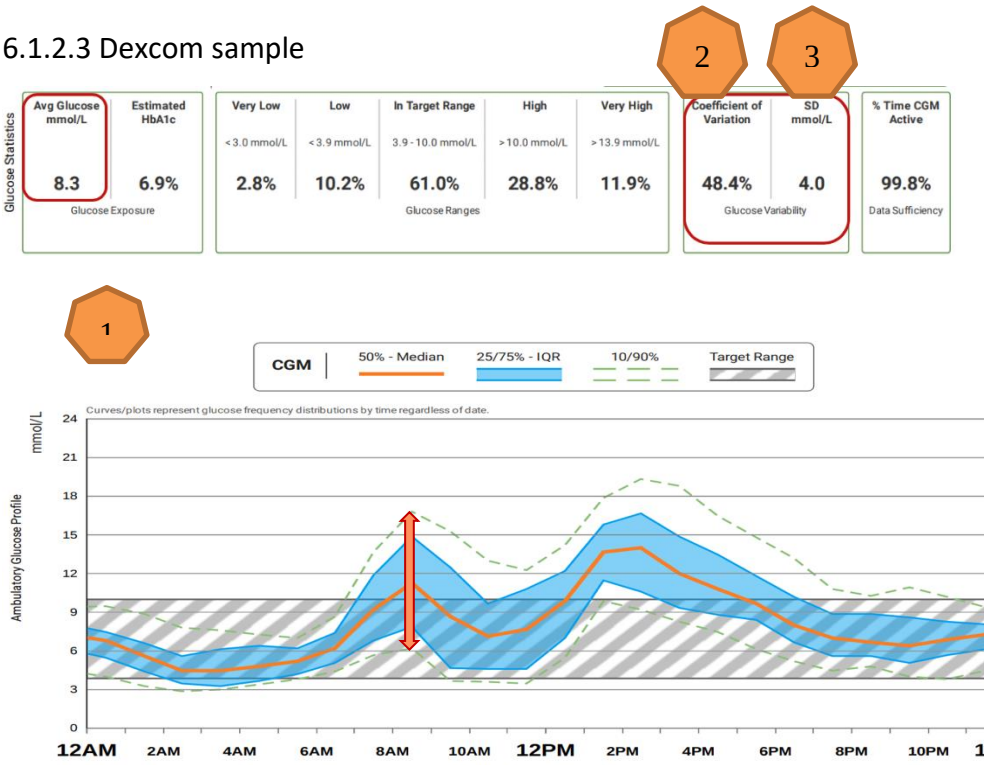




3

Standard Deviation
If SD > mean glucose / 3 = High variability[9]

6.1.2.3 Dexcom sample



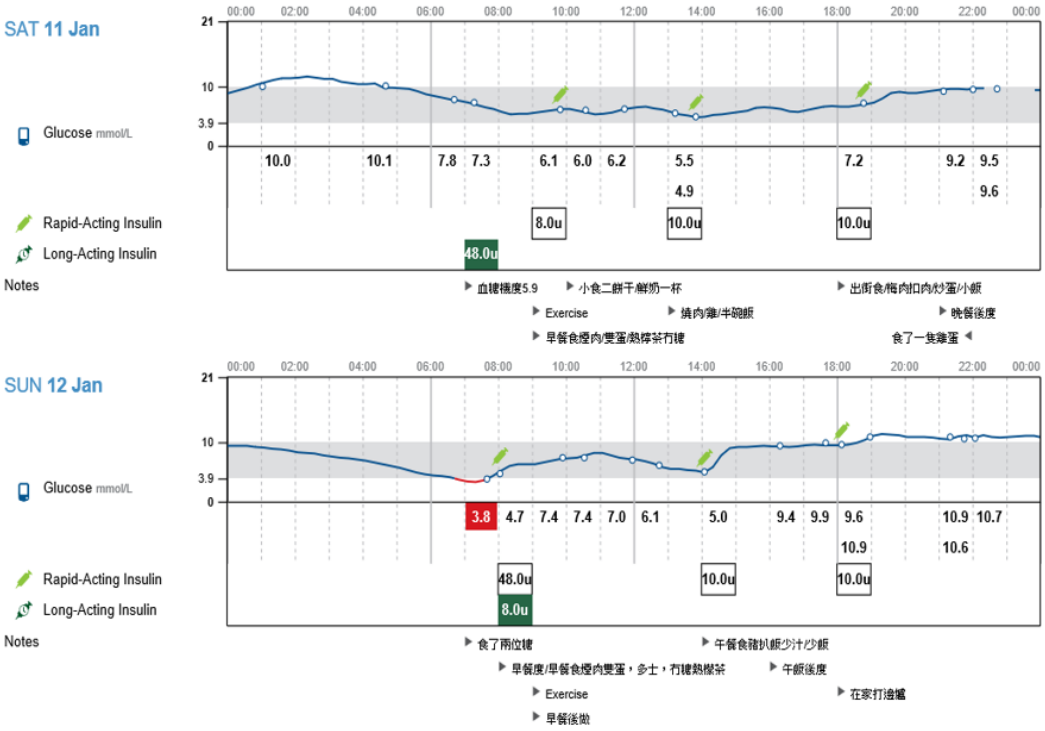
7 Identify the possible contributors of midnight hypoglycemia/hyperglycemia[14] Level VA

- 7.1 Basal rates or long acting insulin dose
- 7.2 Physical activity including type, duration and time of day
- 7.3 Alcohol intake
- 7.4 Other evening activities

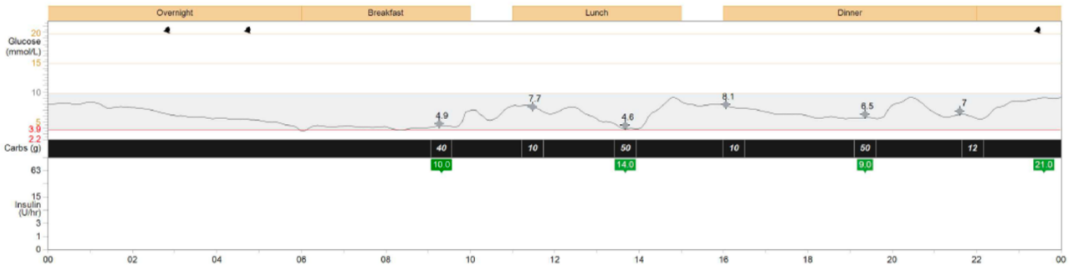
8 Identify the possible contributors of daytime hypoglycemia/hyperglycemia[14]

- 8.1 Physical activity including type, duration and time of day
- 8.2 Meal/insulin dosing times
- 8.3 Missing meal after insulin dosing or missed mealtime insulin dose
- 8.4 Meal quality (high or low glycemic index)
- 8.5 Insulin stacking from aggressive use of correction dose
- 8.6 Inappropriate insulin carbohydrate ratio or insulin sensitivity factor

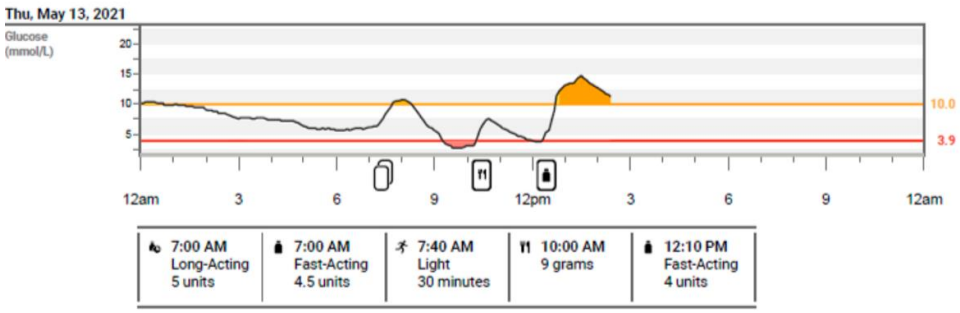
8.6.1 Libre Sample



8.6.2 Medtronic Sample



8.6.3 Dexcom Sample



9 Agree on an action plan with the patient[14,20] Level VA

9.1 Get rid of lows overnight: reduce insulin and modify the behavior factors

9.2 Reduce variability: insulin timing and amount of food, consider carb counting

9.3 Look at least 12-18 hours past the time of hyperglycemia for secondary effects on glucose (hypoglycemia) when treating a pattern of hyperglycemia, address the hypoglycemia.

9.4 Repeat 2-week profile if not achieve in TIR

9.5 Teach how to use trend arrows

Rate of change trend Arrows in CGM systems in Hong Kong Market

	Medtronic – Guardian Connect	Dexcom – G6	Abbott – Freestyle Libre
↑ ↑ ↑	Glucose rising at rate ≥ 0.17mmol/L per minute	N/A	N/A
↑ ↑	Glucose rising at rate ≥ 0.11mmol/L per minute but <0.17 mmol/L per minute	Glucose rapidly rising ≥ 0.16mmol/L per minute	N/A
↑	Glucose rising at rate ≥ 0.06mm0l/L per minute but <0.11 mmol/L per minute	Glucose rising 0.11 - 0.16mmol/L per minute	Very rapidly rising glucose levels, rising at a rate >0.11 mmol/L per minute
↗	N/A	Glucose slowly rising 0.06 -0.11 mmol/L per minute	Moderately rising glucose level, rising at a rate between 0.06 and 0.11mmol/L per minute

→	N/A	Steady, glucose increasing/decreasing > 0.06 mmol/L per minute	Gradually rising or falling glucose levels, falling or rising at a rate between 0-0.06 mmol/L
↘	N/A	Glucose slowly falling 0.06 -0.11 mmol/L per minute	Moderately falling glucose level, falling at a rate between 0.06-0.11mmol/L per minute
↓	Glucose falling at rate of ≥ 0.06mm0l/L per minute but <0.11	Glucose falling 0.11 - 0.16mmol/L per minute	Very rapidly falling glucose levels, falling at a rate > 0.11 mmol/L per minute
↓ ↓	Glucose falling at rate of ≥ 0.11mmol/L per minute but <0.17 mmol/L per minute	Glucose rapidly falling ≥ 0.16mmol/L per minute	N/A
↓ ↓ ↓	Glucose falling at rate of ≥ 0.17mmol/L per minute	N/A	N/A

10 Summary of CGM data interpretation steps [22] Level IVA

10.1 Review the data sufficiency and accuracy

10.2 Mark the factors that may affect the management plan in the daily profile sheet

10.3 Ask patients to express their thoughts on own profiles and let patients provide honest, helpful insights to explain the glucose patterns

10.4 Looking for patterns of low glucose level

10.5 Looking for pattern of high glucose level

10.6 Look for areas of wide glucose variability

10.7 Identify the possible contributors of midnight hypoglycemia/hyperglycemia

10.8 Identify the possible contributors of daytime hypoglycemia/hyperglycemia

10.9 Agree on an action plan with the patient

Remarks:

The unique CGM report features are presented in different systems such as hourly or daily TIR, the best day of glucose profile during the monitoring period, mean glucose before and after meal. Please refer to the specific features in different CGM reports.

Documentation

Model of CGM : _____

Study period : _____

Data capture : _____%

Patient's Name:

Age / Sex:

SOPD No:

Glucose exposure:

Average glucose: _____ mmol/L +/- SD _____

Glucose Management Indicator (GMI): _____%

Glucose Variability: _____%

(Define as percentage coefficient of variation (%CV); target ⩽36%)

Time in Range

Above 13.9 mmol/L_____%

10.1 -13.9 mmol/L _____%

3. 9 - 10 mmol/L _____%

3.0 - 3.8 mmol/L _____%

Below 3 mmol/L _____%

Glucose Pattern:

Hypoglycemia_____

_____

Hyperglcyemia_____

_____

References

1. Danne T, Nimri R, Battelino T, et al. (2017). International consensus on use of continuous glucose monitoring. Diabetes Care 2017;40:1631–1640
2. Xing D, Kollman C, Beck RW, et al. (2011). Optimal sampling intervals to assess long-term glycemic control using continuous glucose monitoring. Diabetes Technology Therapeutics, 13:351–358.
3. Riddlesworth TD, Beck RW, Gal RL, et al. (2018). Optimal sampling duration for continuous glucose monitoring to determine long-term glycemic control. Diabetes Technology & Therapeutics, 20:314–316.
4. Lu J, Ma X, Zhou J, et al. (2018). Association of time in range, as assessed by continuous glucose monitoring, with diabetic retinopathy in type 2 diabetes. Diabetes Care, 41:2370–2376
5. Bergenstal, R. M., Beck, R. W., Close, K. L., Grunberger, G., Sacks, D. B., Kowalski, A., ... & Cefalu, W. T. (2018). Glucose management indicator (GMI): a new term for estimating A1C from continuous glucose monitoring. *Diabetes care*, *41*(11), 2275-2280.
6. Beck, R. W., Connor, C. G., Mullen, D. M., Wesley, D. M., & Bergenstal, R. M. (2017). The fallacy of average: how using HbA1c alone to assess glycemic control can be misleading. *Diabetes Care*, *40*(8), 994-999.
7. Bergenstal RM, Garg S,Weinzimer SA, et al. (2016). Safety of a hybrid closed- loop insulin delivery system in patients with type 1 diabetes. JAMA 2016;316:1407–1408
8. Beck, R. W., Bergenstal, R. M., Riddlesworth, T. D., Kollman, C., Li, Z., Brown, A. S., & Close, K. L. (2019). Validation of Time in Range as an Outcome Measure for Diabetes Clinical Trials. Diabetes care, 42(3), 400–405. https://doi.org/10.2337/dc18-1444
9. Jingyi Lu, Xiaojing Ma, Jian Zhou, Lei Zhang, Yifei Mo, Lingwen Ying, Wei Lu, Wei Zhu, Yuqian Bao, Robert A. Vigersky, Weiping Jia. (2018). Association of Time in Range, as Assessed by Continuous Glucose Monitoring, With Diabetic Retinopathy in Type 2 Diabetes. *Diabetes Care,* 41 (11): 2370-2376. https://doi.org/10.2337/dc18-1131
10. Vigersky RA, & McMahon C. (2019). The relationship of hemoglobin A1C to time-in-range in patients with diabetes. *Diabetes Technol Ther,*21: 81-85. https://doi.org/10.1089/dia.2018.0310

11. Beck, R. W., Bergenstal, R. M., Cheng, P., Kollman, C., Carlson, A. L., Johnson, M. L., & Rodbard, D. (2019). The relationships between time in range, hyperglycemia metrics, and HbA1c. *Journal of diabetes science and technology*, *13*(4), 614-626.
12. Beck, R. W., Bergenstal, R. M., Riddlesworth, T. D., Kollman, C., Li, Z., Brown, A. S., & Close, K. L. (2019). Validation of Time in Range as an Outcome Measure for Diabetes Clinical Trials. Diabetes care, 42(3), 400–405. https://doi.org/10.2337/dc18-1444
13. Battelino, T., Danne, T., Bergenstal, R. M., Amiel, S. A., Beck, R., Biester, T., ... & Dovc, K. (2019). Doyle FJ 3rd, Garg S, Grunberger G, Heller S, Heinemann L, Hirsch IB, Hovorka R, Jia W, Kordonouri O, Kovatchev B, Kowalski A, Laffel L, Levine B, Mayorov A, Mathieu C, Murphy HR, Nimri R, Nørgaard K, Parkin CG, Renard E, Rodbard D, Saboo B, Schatz D, Stoner K, Urakami T, Weinzimer SA, Phillip M. Clinical Targets for Continuous Glucose Monitoring Data Interpretation: Recommendations From the International Consensus on Time in Range. *Diabetes Care*, *42*(8), 1593.
14. Holt, R., DeVries, J. H., Hess-Fischl, A., Hirsch, I. B., Kirkman, M. S., Klupa, T., Ludwig, B., Nørgaard, K., Pettus, J., Renard, E., Skyler, J. S., Snoek, F. J., Weinstock, R. S., & Peters, A. L. (2021). The management of type 1 diabetes in adults. A consensus report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetologia*, *64*(12), 2609–2652. https://doi.org/10.1007/s00125-021-05568-3
15. Aleppo, G., & Webb, K. (2019). Continuous glucose monitoring integration in clinical practice: a stepped guide to data review and interpretation. *Journal of diabetes science and technology*, *13*(4), 664-673.
16. American Diabetes Association (2021) 12. Older Adults: Standards of Medical Care in Diabetes—2021. *Diabetes Care* 1 January 2021; 44 (Supplement_1): S168–S179. https://doi.org/10.2337/dc21-S012
17. Petersson J, Åkesson K, Sundberg F, Särnblad S. (2019). Translating glycated hemoglobin A1c into time spent in glucose target range: a multicenter study. *Pediatr Diabetes*,20: 339-344.
18. Monnier, L., Colette, C., Wojtusciszyn, A., Dejager, S., Renard, E., Molinari, N., & Owens, D. R. (2017). Toward defining the threshold between low and high glucose variability in diabetes. *Diabetes care*, *40*(7), 832-838.
19. Hirsch, I. B. (2005). Glycemic variability: it's not just about A1C anymore!. *Diabetes technology & therapeutics*, *7*(5), 780-783.
20. Messer, L. H., Forlenza, G. P., Sherr, J. L., Wadwa, R. P., Buckingham, B. A., Weinzimer, S. A., ... & Slover, R. H. (2018). Optimizing hybrid closed-loop therapy in adolescents and emerging adults using the MiniMed 670G system. *Diabetes Care*, *41*(4), 789-796.

21. Bergenstal R. (2018). Continuous glucose monitoring data as an adjunct to A1C. In: Hirsch IB, Battelino T, Peters AL, Chamberlain JJ, Aleppo G, Bergenstal RM, eds. Understanding Continuous Glucose Monitoring Data, Arlington, VA: American Diabetes Association; 2018:19-20
22. Johnson, M. L., Martens, T. W., Criego, A. B., Carlson, A. L., Simonson, G. D., & Bergenstal, R. M. (2019). Utilizing the ambulatory glucose profile to standardize and implement continuous glucose monitoring in clinical practice. Diabetes technology & therapeutics, 21(S2), S2-17.

Conclusion

CGM is a useful tool to provide data for health care professionals and people with diabetes to better manage diabetes. The development of CGM technology has progressed rapidly in recent years including accuracy, simple procedures of sensor insertion, and reduced frequency of sensor calibration. As CGM becomes more affordable and easily accessible, there is rapidly increasing trend for its use by individuals with diabetes and health care professionals and mounting demand for diabetes nurses in Hong Kong to acquire the new knowledge of and skills in different models of CGM. Through literature search, an EBP question was set as "How to enhance patient outcomes through training and practical guide on continuous glucose monitoring (CGM) for diabetes nurses?"

By adopting the Johns Hopkins Nursing Evidence-Based Practice (JHKEBP) Appraisal Tool, the evidence, evidence levels and qualities of the findings have been appraised in writing this AHKDN Guidebook, which clearly illustrates the indications for CGM; information about different CGM models; nursing practice guide for CGM, education materials for people with diabetes; and interpretation of CGM results and reporting.

It is envisaged that this informative practice guide will facilitate our diabetes nurses to prepare and supervise their patients on using CGM, thus enabling individuals with diabetes to gain the most benefits from the modern technology, and ultimately improving their clinical outcomes.