FEATURE ARTICLE

Structured Blood Glucose Monitoring in Primary Care: A Practical, Evidence-Based Approach

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Comprehensive care of diabetes requires satisfactory stewardship of an underutilized prescription in diabetes management: the prescription for structured blood glucose monitoring (BGM). Structured BGM is a recommended schedule of actionable blood glucose measurements taken at specific times with the intent of using the data for individualized patient education and therapeutic intervention. The utility of different BGM protocols is logically dictated by a patient's therapeutic regimen. This article reviews the prescription for structured BGM in the setting of intensive insulin, nonintensive basal insulin, and noninsulin treatment regimens. Evidence-based prescriptions of structured 5- to 7-point BGM profiles in diabetes provide essential information for productive clinician- and patient-directed therapeutic interventions. The effective implementation of structured BGM aids clinicians in achieving the desired goal of A1C reduction while bolstering patient education and empowering self-management.

Due to clinical demands and time constraints, blood glucose monitoring (BGM) is too often prescribed in a nonstructured manner through which patients receive brief, minimal instruction regarding how and when to measure their blood glucose levels. In an observational cohort study of 7,320 patients with noninsulin-treated type 2 diabetes, nearly one in six patients practiced BGM without either the patient or the clinician using the results (1). Herein lies the value of developing a broader understanding of evidence-based use of BGM to direct patient-allied therapeutic decisions. The ultimate goal of BGM is to improve clinically significant outcomes, namely A1C reduction, which directly correlates to diabetes complications, and avoidance or minimization of hypoglycemia (2,3).

Structured BGM, defined as a schedule of actionable blood glucose measurements taken at specific times with the intent of using the data for individualized patient education and therapeutic intervention, is best positioned to achieve the above-stated goals. However, the outcome benefit of structured BGM varies relative to pharmacologic treatment regimens: intensive insulin, nonintensive basal insulin, or noninsulin therapy. Structured BGM yields a clear benefit for insulin-treated type 1 or type 2 diabetes, whereas the benefit is less clear for noninsulin-treated type 2 diabetes. In this article, we will outline practical approaches to BGM relative to specific therapeutic regimens while addressing common BGM barriers to efficacy (Table 1).

BGM in Intensive Insulin Treatment Regimens

Intensive insulin regimens include continuous subcutaneous insulin infusion (insulin pump therapy) and multiple daily injections and thus are used in all patients with type 1 diabetes and typically also in advanced type 2 diabetes. There is established microvascular benefit and likely macrovascular benefit with the use of BGM to guide intensive insulin treatment regimens, with further positive correlation of BGM frequency and A1C reduction (2–6). However, intensive insulin treatment also increases the risk for hypoglycemia.

The American Diabetes Association (ADA) *Standards of Medical Care in Diabetes—2020* reflects a balance of BGM use for insulin intensification and hypoglycemia reduction, with a recommendation that most people on an intensive insulin regimen use either BGM or continuous glucose monitoring (CGM) to assess glucose levels before meals and snacks, at bedtime, before and while performing exercise and critical tasks, and when they suspect or need to treat hypoglycemia (7).

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TABLE 1 Summarized Structured BGM Recommendations Based on Therapeutic Regimen

Therapeutic Regimen	Recommended Structured BGM
Intensive insulin (insulin pump or multiple daily injections)	Paired pre- and postprandial measurements plus fasting/bedtime measurement in a predetermined 5- to 7-point blood glucose profile; increased monitoring for hypoglycemia, exercise, and critical tasks
Nonintensive basal insulin	FBG measurements for insulin titration; pre- and postprandial measurements when A1C is above goal with normal FBG to assess postprandial hyperglycemia
Noninsulin therapy	Use of BGM based on individualized needs (e.g., hypoglycemia risk, need for therapy adjustments, or patient education)

Blood glucose measurements taken randomly when compared with prescribed structured BGM for the purpose of patient behavior feedback (i.e., meals, activity, and sleep) have not been shown to be beneficial, whereas structured BGM performed at specific times and used to elucidate patterns of blood glucose levels resulting from behaviors has led to improved glycemic control (8). As stated in guidelines from the International Diabetes Federation (IDF), "intensive" or "focused" BGM protocols create actionable glucose profiles by providing five to seven measurements per day over 1–3 days or through "staggered" testing over the course of a week (e.g., Monday pre- and postprandially around breakfast, Tuesday pre- and postprandially around lunch, Wednesday pre- and postprandially around dinner, and so forth) (9).

Table 2 shows a sample staggered BGM profile. Such a schedule is a conscientious approach that minimizes daily fingersticks and resource utilization, while still providing fasting and prandial data points to identify daily glucose excursions and the need for pharmacologic therapy or behavioral modification.

Structured BGM schedules described in the literature typically use a 7-point glucose profile for intensive monitoring, including pre- and postprandial measurements around breakfast, lunch, and dinner plus a measurement at bedtime. Such a BGM schedule can be followed daily for 3 consecutive days per week or weekly as best meets the needs of specific patients. A 7-point profile schedule for 3 consecutive days per week is shown in Table 3. This schedule provides a comprehensive assessment of daily glucose variability without the burden of daily testing. Kato and Kato (10) studied 7-point profiles performed during 3 consecutive days per month in people with type 1 and insulin-treated type 2 diabetes and showed significant A1C reductions when treatment adjustments were made based on BGM data compared with usual randomly performed BGM (A1C −0.4% with structured BGM vs. −0.1% with routine random BGM, $P < 0.007$).

Alternative BGM profiles include 5-point (pre- and postprandial breakfast, postprandial lunch, and pre- and postprandial dinner) or 6-point (pre- and postprandial breakfast, lunch, and dinner) or a staggered BGM regimen in which paired pre- and postprandial meal-specific measurements are attained on staggered days of the week, as aforementioned.

All of these prescribed profiles provide a comprehensive view of daily fasting and prandial blood glucose levels, but they are not complete without also documenting

TABLE 2 Sample Staggered 6-Point BGM Regimen

	Pre-Breakfast	Post-Breakfast	Pre-Lunch	Post-Lunch	Pre-Dinner	Post-Dinner
Sunday	X	X				
Monday	X	X				
Tuesday			X	X		
Wednesday					X	X
Thursday	X	X				
Friday			X	X		
Saturday					X	X

TABLE 3 A 7-Point BGM Profile Schedule for 3 Consecutive Days of the Week

	Pre-Breakfast	Post-Breakfast	Pre-Lunch	Post-Lunch	Pre-Dinner	Post-Dinner	Bedtime
Sunday							
Monday							
Tuesday	X	X	X	X	X	X	X
Wednesday	X	X	X	X	X	X	X
Thursday	X	X	X	X	X	X	X
Friday							
Saturday							

nutrition, activity, and stressors (e.g., changes in diet, exercise, and acute illness) to allow for immediate feedback on the impact of behaviors with regard to glucose excursions.

This approach requires both clinicians and people with diabetes (PWD) to attain the skills and willingness to incorporate BGM values into timely nonpharmacologic and pharmacologic regimen adjustments (9). For patients on intensive insulin regimens, we recommend becoming familiar with and prescribing a blood glucose log similar to the one provided in the ADA's *Practical Insulin: A Handbook for Prescribing Providers*, 5th edition, which correlates with a prescribed blood glucose profile (11). Table 4 is an example of such a log, which allows for a 7-point profile with comments and also exhibits fasting blood glucose (FBG) and postprandial blood glucose goals for patients' reference. Effective use of logged blood glucose profiles includes both clinician-directed therapeutic adjustments and patient education to facilitate future patient-directed behavioral and pharmacologic adjustments.

It is well recognized that many, if not most, PWD requiring an intensive insulin therapy regimen will not strictly follow a prescribed monitoring schedule for reasons

TABLE 4 Sample Blood Glucose Log for Intensive Insulin Treatment Regimens

Date	Time	Breakfast		Time	Lunch		Time	Dinner		Bedtime
		Pre-	Post-		Pre-	Post-		Pre-	Post-	
Medicine/comments:										
Medicine/comments:										
Medicine/comments:										
Medicine/comments:										
Medicine/comments:										
Medicine/comments:										
Medicine/comments:										
Target A1C: <7%				Target FBG: 80–130 mg/dL				Target postprandial BG <180 mg/dL		

BG, blood glucose. Adapted from ref. 11.

TABLE 5 Sample Blood Glucose Log for Daily Basal Insulin Titration With Entries

Date	FBG, mg/dL (Target: 80–130 mg/dL; if >130 mg/dL, increase insulin by 1 unit*)	Insulin Dose, units	Comments (Note exercise, meal times/nutrition, and dose adjustments; call provider if FBG is <60 mg/dL)
7/16	280	15	Taking at bedtime, had ice cream after dinner
7/17	246	16	Increased by 1 unit, skipped dinner
7/18	155	17	Increased by 1 unit, started walking program

*Daily basal insulin titration is not recommended with ultra-long-acting basal insulin products.

including inconvenience, expense, physical discomfort from testing, and difficulty remembering to do such frequent monitoring when asymptomatic (12). Additionally, once PWD recognize how their blood glucose responds to particular meals and behaviors, they may choose to selectively test at times when they have noted unwanted glucose excursions. For example, some patients may find hypoglycemia occurring only after breakfast and then desist in testing before or after other meals because of the lack of meaningful readings that might alter their treatment regimen, activity, or diet at those other times.

In the event of hypoglycemia, PWD should be educated to perform BGM in 15-minute intervals after hypoglycemia treatment until normoglycemia is achieved and sustained (i.e., at least three successive blood glucose levels sufficiently above the hypoglycemic risk threshold [>70 mg/dL] to confirm resolution of the hypoglycemic episode).

BGM in Nonintensive Basal Insulin Treatment Regimens

ADA recommendations are less prescriptive for patients taking less frequent insulin injections, stating that BGM may help to guide treatment decisions and self-management (7). FBG measurements are necessary in the titration of basal insulin; thus, there is an obvious need for BGM at least once daily in such regimens (13,14). As many as 60% of patients with type 2 diabetes who are taking one or two oral agents and who initiate basal insulin are able to attain a satisfactory A1C by titrating their insulin to reach their FBG goal. Hence, these patients will only need to perform fasting BGM to reach their therapeutic dose of basal insulin (15). Table 5 provides an example of a blood glucose log designed to aid in self-titration of basal insulin.

When A1C targets are not attained despite FBG results in the target range (80–130 mg/dL for a target A1C of 7%), postprandial excursions are implicated. Pre- and postprandial measurements taken 1–2 hours after the onset of a meal (patients may initially choose the largest meal of the day, which typically contains the highest glycemic index) should be evaluated to determine the degree of postprandial hyperglycemia in the setting of discordant A1C and FBG measurements (16).

Pharmacologic interventions should be initiated to target a postprandial blood glucose of <180 mg/dL. Moreover, there is a growing body of evidence that postprandial hyperglycemia is a risk factor for cardiovascular mortality independent of A1C and should not be ignored despite the A1C goal being met (17–19). As with intensive insulin therapy regimens, more comprehensive blood glucose profiles (e.g., a 7-point profile) may help to identify postprandial hyperglycemia and serve as impactful patient education to guide changes to diet and lifestyle. One time- and resource-sensitive approach is to have patients obtain a 7-point profile on 3 consecutive days either monthly or just for the week before follow-up clinic visits. This practice allows for a comprehensive snapshot of a patient's personal glucose variability.

BGM in Noninsulin Treatment Regimens

Because of heterogeneity of BGM interventions and study populations, trials to assess the efficacy of BGM in noninsulin-treated PWD have yielded conflicting data and have failed to provide consistent evidence that there is a clinically significant long-term impact of BGM on A1C reduction in this setting. Young et al. (20) found that BGM in noninsulin-treated PWD accomplished no notable differences in A1C or health-related quality-of-life measures compared with patients not performing BGM. Similarly, the ESMON (Efficacy of Self-Monitoring of Blood Glucose in Patients With Newly Diagnosed Type 2 Diabetes) study (21) found no significant difference in A1C in noninsulin-treated PWD; in addition, it found a 6% higher score on a depression subscale of a well-being questionnaire ($P = 0.01$), drawing attention to the

potential for negative quality-of-life impact related to a potentially painful and costly intervention.

It is worth noting that studies using structured BGM versus those using unstructured BGM have shown greater benefit in glycemic control for noninsulin-treated PWD. One 12-month prospective study randomized 483 insulin-naive patients with poorly controlled type 2 diabetes (A1C ≥7.5%) from 34 U.S. primary care practices to an active control group (ACG) with usual care or a structured testing group (STG) who underwent at least quarterly use of structured BGM. STG patients and physicians were trained to collect and interpret 7-point glucose profiles over 3 consecutive days. At 12 months, a significant reduction was demonstrated in mean A1C in the STG compared with the ACG (−1.2 vs. −0.9%, $P = 0.04$) (22).

Among the patient populations in which clinical trials have demonstrated inconsistent evidence of A1C reduction, the barriers of cost, pain, and inconvenience make BGM hard to justify. This point is further illustrated by the decisions of medical organizations such as the Endocrine Society to launch a Choosing Wisely campaign to adopt recommendations against daily BGM for people with noninsulin-treated type 2 diabetes (23). The ADA states that, although BGM with noninsulin therapies has not shown reductions in A1C, it may be helpful when altering diet, physical activity, or medications that can cause hypoglycemia (i.e., sulfonylureas and meglitinides) in conjunction with a treatment adjustment program (7). The IDF recommendations corroborate the need for data to be evaluated and used for therapy adjustments as a component of optimum and productive use of BGM and harmonize with ADA guidelines regarding an individualized approach based on patients' needs, interest, skill level, resources, and disabilities (9). However, the IDF also released guidelines for BGM use in noninsulin-treated diabetes in 2017 that recommended consideration of BGM at the time of diagnosis and as part of ongoing diabetes self-management education. The IDF further endorses using 5- to 7-point BGM profiles for short, focused periods of time (e.g., monthly) in noninsulin-treated type 2 diabetes (9). The need for responsive therapy management and an individualized approach are the two consistent recommendations to keep in mind when considering BGM use for any type of diabetes treatment regimen.

Optimizing BGM: Identifying and Overcoming Barriers

For BGM to be both successful and productive, technical proficiency on the part of patients (i.e., appropriate sampling and meter use) is only part of the equation; patients and clinicians also must be concordant on appropriate goals, and clinicians must demonstrate their use of whatever actionable information is obtained through BGM. Otherwise, patients may rightly view BGM as a ritual rather than a meaningful and useful practice.

Perhaps the most obvious barriers to both clinicians and PWD are time and resources. Fortunately, new technologies have provided us with smartphone applications that support clinician-directed patient education and prescription of BGM, including carbohydrate counting, calorie and diet tracking, and weight management. These clinically validated digital health technologies are termed "digiceuticals" (24) or mHealth (short for mobile health), as defined by WHO (25). Articles elsewhere in this special-topic issue of *Clinical Diabetes* provide more in-depth discussion of the use of mHealth technologies (p. 449 and p. 486).

Another patient-related barrier to BGM is the pain associated with multiple daily fingersticks. While progress in sampling tools has reduced discomfort, some individuals find BGM sufficiently unpleasant that they do not follow their recommended BGM schedule. This circumstance would be especially predictable among people for whom fingertip acroesthesia could compromise vocational or avocational prowess (e.g., pianists, computer technicians, guitarists, or massage therapists).

A potential solution to the acroesthesia concern is alternative site testing (AST). To be considered an alternative site, the location must *1*) be less innervated and thus less painful, *2*) have sufficient supple subcutaneous tissue to provide adequate sampling, and *3*) not require the assistance of another person. The forearm and thigh are two sites that have shown comparable glucose levels to fingertip samples; unfortunately, these sites are somewhat less accurate in hypoglycemic states (requiring confirmation by fingerstick if a borderline hypoglycemia result is obtained) and may lag behind in the setting of rapidly changing glucose levels (i.e., 60–90 minutes postprandially) (26,27). Ironically, AST has not been demonstrated to result in improved BGM performance compared with fingertip blood glucose samplings despite findings of improved glycemic control when used (28).

So, for whom might AST be a preferred option? One obvious answer is that it could reduce barriers for insulin-treated PWD who find the discomfort of multiple daily BGM overly burdensome and who are not candidates for CGM. These identified PWD must also have sufficient insight into their personal glucose variability to recognize

when confirmation of AST with fingertip testing would be necessary (e.g., when glucose levels may be rapidly changing or when hypoglycemia signs or symptoms are present (29). Finally, fingertip sampling remains the gold standard for glucose meter calibration.

BGM Relevance With the Advent of CGM

CGM technology is advancing daily and showing more promising data with each advancement. CGM can be an effective tool for PWD who require more intensive BGM (30,31). Complex insulin regimens that require high-frequency testing (more than four times daily) are at high risk of hypoglycemia (including those with hypoglycemia unawareness). CGM is a tool that has been shown to reduce glucose variability and decrease level 1 hypoglycemia (blood glucose ≥54–70 mg/dL), in addition to facilitating improved long-term control measures (i.e., A1C) and improving metrics of glucose time in range (32).

Unfortunately, the prescription of CGM is constrained by insurance plan requirements, which although not evidence-based, identify patients eligible for CGM coverage by their frequency of BGM (more than four times daily) and type of diabetes (type 1 or insulin-treated type 2 diabetes) (33). Additional clinician-recognized, patient-specific prerequisites include mHealth literacy and willingness to adhere to continuous or near-continuous use of a CGM device (34).

It should also be recognized that, presently, CGM use does not obviate the need for fingerstick BMG (35). Most next-generation CGM devices no longer require calibration, which will be welcomed by many patients for whom fingerstick procedures have been burdensome. Nonetheless, fingerstick BGM confirmation will be necessary even for those who are using next-generation CGM devices whenever extremes of glucose are reported (low glucose <40 mg/dL and high glucose >400 mg/dL) (36–38). Expense, and sometimes personal preference, will preclude some individuals from utilizing CGM devices, so traditional BGM will remain a logical useful tool for the foreseeable future. Since recent clinical trial data indicate that the CGM-determined metric of time in range is associated with mortality, the first pieces of evidence confirming CGM benefits for hard outcomes are beginning to fall into place (39).

Decisions about when and how to choose CGM should be made through a shared decision-making process between clinicians and PWD. An article elsewhere in this *Clinical Diabetes* special-topic issue provides an in-depth discussion of CGM in clinical practice (p. 429).

Conclusion

BGM is a valuable tool, as long as one adheres to the old aphorism about "the right tool for the right patient at the right time." The power of BGM is only as great as the combined strengths of patients' concordance and clinicians' awareness of the necessity of actually acting on actionable BGM information (37). Structured 5- to 7-point BGM profiles can empower PWD to play a more active role in the management of their disease, as well as improve the efficacy and safety of glucose-lowering therapeutics (36). Clinicians and patients both play key roles in documenting, interpreting, and using the data obtained through BGM. Clinicians are encouraged to practice and perhaps more importantly, to educate their patients about pattern recognition when assessing blood glucose logs so PWD are positioned to make timely therapeutic modifications toward better glycemic control. Effective use of structured BGM prescriptions is worth the time and resources needed to implement them.

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A.D.L. and J.J. researched data and wrote the manuscript with equal contribution. L.K. reviewed/edited the manuscript. A.D.L. is guarantor of this work and, as such, had full access to all of the references used and takes responsibility for the integrity and accuracy of this review.

REFERENCES

1. Grant RW, Huang ES, Wexler DJ, et al. Patients who self-monitor blood glucose and their unused testing results. Am J Manag Care 2015;21:e119–e129

2. Nathan DM, Cleary PA, Backlund JY, et al.; Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications (DCCT/EDIC) Study Research Group. Intensive diabetes treatment and cardiovascular disease in patients with type 1 diabetes. N Engl J Med 2005;353:2643–2653

3. Holman RR, Paul SK, Bethel MA, Matthews DR, Neil HA. 10-Year follow-up of intensive glucose control in type 2 diabetes. N Engl J Med 2008;359:1577–1589

4. Nathan DM, Genuth S, Lachin J, et al.; Diabetes Control and Complications Trial Research Group. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. N Engl J Med 1993;329:977–986

5. UK Prospective Diabetes Study Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). Lancet 1998;352:837–853

6. Miller KM, Beck RW, Bergenstal RM, et al.; T1D Exchange Clinic Network. Evidence of a strong association between frequency of self-monitoring of blood glucose and hemoglobin A1c levels in T1D Exchange clinic registry participants. Diabetes Care 2013;36:2009–2014

7. American Diabetes Association. 7. Diabetes technology: *Standards of Medical Care in Diabetes—2020*. Diabetes Care 2020;43(Suppl. 1):S77–S88

8. Parkin CG, Davidson JA. Value of self-monitoring blood glucose pattern analysis in improving diabetes outcomes. J Diabetes Sci Technol 2009;3:500–508

9. International Diabetes Federation. Self-monitoring of blood glucose in non-insulin treated type 2 diabetes. Available from https://www.idf.org/e-library/guidelines/85-self-monitoring-of-blood-glucose-in-non-insulin-treated-type-2-diabetes.html. Accessed 13 August 2020

10. Kato NK, Kato M. Use of structured SMBG helps reduce A1c levels in insulin-treated diabetic patients (Abstract). Diabetes 2011;60(Suppl. 1):A239

11. American Diabetes Association. *Practical Insulin: A Handbook for Prescribing Providers*. 5th ed. Arlington, VA, American Diabetes Association, 2019

12. Moström P, Ahlén E, Imberg H, Hansson PO, Lind M. Adherence of self-monitoring of blood glucose in persons with type 1 diabetes in Sweden. BMJ Open Diabetes Res Care 2017;5:e000342

13. Rosenstock J, Davies M, Home PD, Larsen J, Koenen C, Schernthaner G. A randomised, 52-week, treat-to-target trial comparing insulin detemir with insulin glargine when administered as add-on to glucose-lowering drugs in insulin-naive people with type 2 diabetes. Diabetologia 2008;51:408–416

14. Garber AJ. Treat-to-target trials: uses, interpretation and review of concepts. Diabetes Obes Metab 2014;16:193–205

15. Riddle MC, Rosenstock J, Gerich J; Insulin Glargine 4002 Study Investigators. The Treat-to-Target trial: randomized addition of glargine or human NPH insulin to oral therapy of type 2 diabetic patients. Diabetes Care 2003;26:3080–3086

16. Weinstock RS, Hirsch IB, Mulder JE. Self-monitoring of glucose in management of nonpregnant adults with diabetes mellitus. Available from https://www.uptodate.com/contents/self-monitoring-of-glucose-in-management-of-nonpregnant-adults-with-diabetes-mellitus. Accessed 13 August 2020

17. Tominaga M, Eguchi H, Manaka H, Igarashi K, Kato T, Sekikawa A. Impaired glucose tolerance is a risk factor for cardiovascular disease, but not impaired fasting glucose: the Funagata Diabetes Study. Diabetes Care 1999;22:920–924

18. Shaw JE, Hodge AM, de Courten M, Chitson P, Zimmet PZ. Isolated post-challenge hyperglycaemia confirmed as a risk factor for mortality. Diabetologia 1999;42:1050–1054

19. Ceriello A, Hanefeld M, Leiter L, et al. Postprandial glucose regulation and diabetic complications. Arch Intern Med 2004;164:2090–2095

20. Young LA, Buse JB, Weaver MA, et al.; Monitor Trial Group. Glucose self-monitoring in non-insulin-treated patients with type 2 diabetes in primary care settings: a randomized trial. JAMA Intern Med 2017;177:920–929

21. O'Kane MJ, Bunting B, Copeland M, Coates VE; ESMON study group. Efficacy of self monitoring of blood glucose in patients with newly diagnosed type 2 diabetes (ESMON study): randomised controlled trial. BMJ 2008;336:1174–1177

22. Polonsky WH, Fisher L, Schikman CH, et al. Structured self-monitoring of blood glucose significantly reduces A1C levels in poorly controlled, noninsulin-treated type 2 diabetes: results from the Structured Testing Program study. Diabetes Care 2011;34:262–267

23. Endocrine Society. Choosing Wisely. Five things physicians and patients should question. Accessed 11 May 2020. Available from http://www.choosingwisely.org/societies/endocrine-society. Accessed 18 August 2020

24. Fleming GA, Petrie JR, Bergenstal RM, Holl RW, Peters AL, Heinemann L. Diabetes digital app technology: benefits, challenges, and recommendations: a consensus report by the European Association for the Study of Diabetes (EASD) and the American Diabetes Association (ADA) Diabetes Technology Working Group. Diabetes Care 2020;43:250–260

25. Park YT. Emerging new era of mobile health technologies. Healthc Inform Res 2016;22:253–254

26. Dufaitre-Patouraux L, Djemli K, Vague P. How and when to use an alternative site in self-monitoring of blood glucose. Diabetes Metab 2004;30:471–477

27. Ellison JM, Stegmann JM, Colner SL, et al. Rapid changes in postprandial blood glucose produce concentration differences at finger, forearm, and thigh sampling sites. Diabetes Care 2002;25:961–964

28. Knapp PE, Showers KM, Phipps JC, et al. Self-monitoring of blood glucose with finger tip versus alternative site sampling: effect on glycemic control in insulin-using patients with type 2 diabetes. Diabetes Technol Ther 2009;11:219–225

29. Jacoby JM. An analysis of alternate site tests to improve patient compliance with self-monitoring of blood glucose. J Diabetes Sci Technol 2010;4:911–912

30. Battelino T, Danne T, Bergenstal RM, et al. Clinical targets for continuous glucose monitoring data interpretation: recommendations from the International Consensus on Time in Range. Diabetes Care 2019;42:1593–1603

31. Carlson AL, Mullen DM, Bergenstal RM. Clinical use of continuous glucose monitoring in adults with type 2 diabetes. Diabetes Technol Ther 2017;19(Suppl. 2):S4–S11

32. Ruedy KJ, Parkin CG, Riddlesworth TD, Graham C; DIAMOND Study Group. Continuous glucose monitoring in older adults with type 1 and type 2 diabetes using multiple daily injections of insulin: results from the DIAMOND trial. J Diabetes Sci Technol 2017;11:1138–1146

33. Anderson JE, Gavin JR, Kruger DF. Current eligibility requirements for CGM coverage are harmful, costly, and unjustified. Diabetes Technol Ther 2020;22:169–173

34. Engler R, Routh TL, Lucisano JY. Adoption barriers for continuous glucose monitoring and their potential reduction

with a fully implanted system: results from patient preference surveys. Clin Diabetes 2018;36:50–58

35. Beck RW, Riddlesworth TD, Ruedy K, et al.; DIAMOND Study Group. Continuous glucose monitoring versus usual care in patients with type 2 diabetes receiving multiple daily insulin injections: a randomized trial. Ann Intern Med 2017;167: 365–374

36. Welsh JB, Gao P, Derdzinski M, et al. Accuracy, utilization, and effectiveness comparisons of different continuous glucose monitoring systems. Diabetes Technol Ther 2019;21: 128–132

37. Christiansen MP, Klaff LJ, Brazg R, et al. A prospective multicenter evaluation of the accuracy of a novel implanted continuous glucose sensor: PRECISE II. Diabetes Technol Ther 2018;20:197–206

38. Hoss U, Budiman ES, Liu H, Christiansen MP. Feasibility of factory calibration for subcutaneous glucose sensors in subjects with diabetes. J Diabetes Sci Technol 2014;8:89–94

39. Lu J, Wang C, Shen Y, et al. Time in range in relation to all-cause and cardiovascular mortality in patients with type 2 diabetes: a prospective cohort study. Diabetes Care. Epub ahead of print on 23 October 2020 (doi: 10.2337/dc20-1862)