The Glucose Pattern Insights (GPI) Report in Primary Care - A Practical Guide

Consensus

This Glucose Pattern Insights (GPI) report practical guide has been written to enable general practitioners to retrospective analyse data, trends and patterns arising from continuous and flash glucose monitors by people living with diabetes. The purpose is to educate and empower general practitioners to work with and enable people living with diabetes to achieve appropriate glucose targets and minimise hypoglycaemia and hyperglycaemia.

Background

There are approximately 1.4 million Australians living with diabetes, with approximately 130,000 people living with type 1 diabetes. Diabetes contributes to 1.2 million hospitalisations and was the 8th leading cause of death in Australia. Furthermore, diabetes is a major contributing factor to the leading cause of death in Australians, that being coronary heart disease. It is estimated that diabetes costs the Australian economy $14.6 billion per annum in direct and indirect costs.

Recent advances in technology and the development of continuous glucose monitoring (CGM) and flash glucose monitoring (FGM) systems have significantly changed the way that people with diabetes can measure their glucose levels. A recent Australian study showed that people with type 1 diabetes who used CGM had lower HbA1c levels, a greater likelihood of achieving a HbA1c of less than 7%, less likelihood of achieving a HbA1c more than 9%, and lower rates of severe hypoglycaemia and diabetic ketoacidosis [1].

The Australian diabetes health professional organisations have recently published a consensus statement advocating for equitable access to diabetes management technologies for people with type 1 diabetes [2]. Since April 2017, the Australian Commonwealth Government has been progressively providing CGM/FGM to people with type 1 diabetes under a subsidy scheme. This means that from July 2022, all Australians living with type 1 diabetes will have the choice of using CGM/FGM to manage their glucose levels. With the potential of 130,000 Australians with type 1 diabetes using CGM/FGM, the amount of data generated and the need for analysis to enable informed clinical decisions has necessitated the development of a structured glucose profiling and data presentation [3, 4].

CGM and FGM enable ready use of real-time monitoring of interstitial glucose levels. Capillary glucose monitoring is reliant on the individual (person) with diabetes conducting a fingerprick test, which can be inconvenient, painful and a barrier to self care. [5]. With the increase in data access via CGM/FGM, the person with diabetes can make timely interpretations and decisions about their glucose management including trends across minutes and hours [6]. In addition, glucose monitoring across a series of 14 days enables glucose summary patterns and profiles to be automatically generated, so the person with diabetes and their health care team can, retrospectively, interpret glucose metrics and patterns in order to help achieve individualised glucose targets, and to minimise hypoglycaemia and hyperglycaemia [7].

This guide focuses on the practical aspects of the clinical effectiveness of glucose profiling in diabetes, emphasising retrospective, summary reporting methods for the General Practitioner.

Understanding the Glucose Pattern Insights (GPI) Report

Professor Roger Mazze and colleagues developed the Ambulatory Glucose Profile (AGP) in the late 1980s when structured memory blood glucose monitoring was being developed [10]. Today, software associated with each device helps assemble glucose levels into summary graphical formats to enable rational data interpretation in the clinical context [7-9]. This has been further refined and updated into the Glucose Pattern Insights (GPI) report specifically designed for general practitioners.

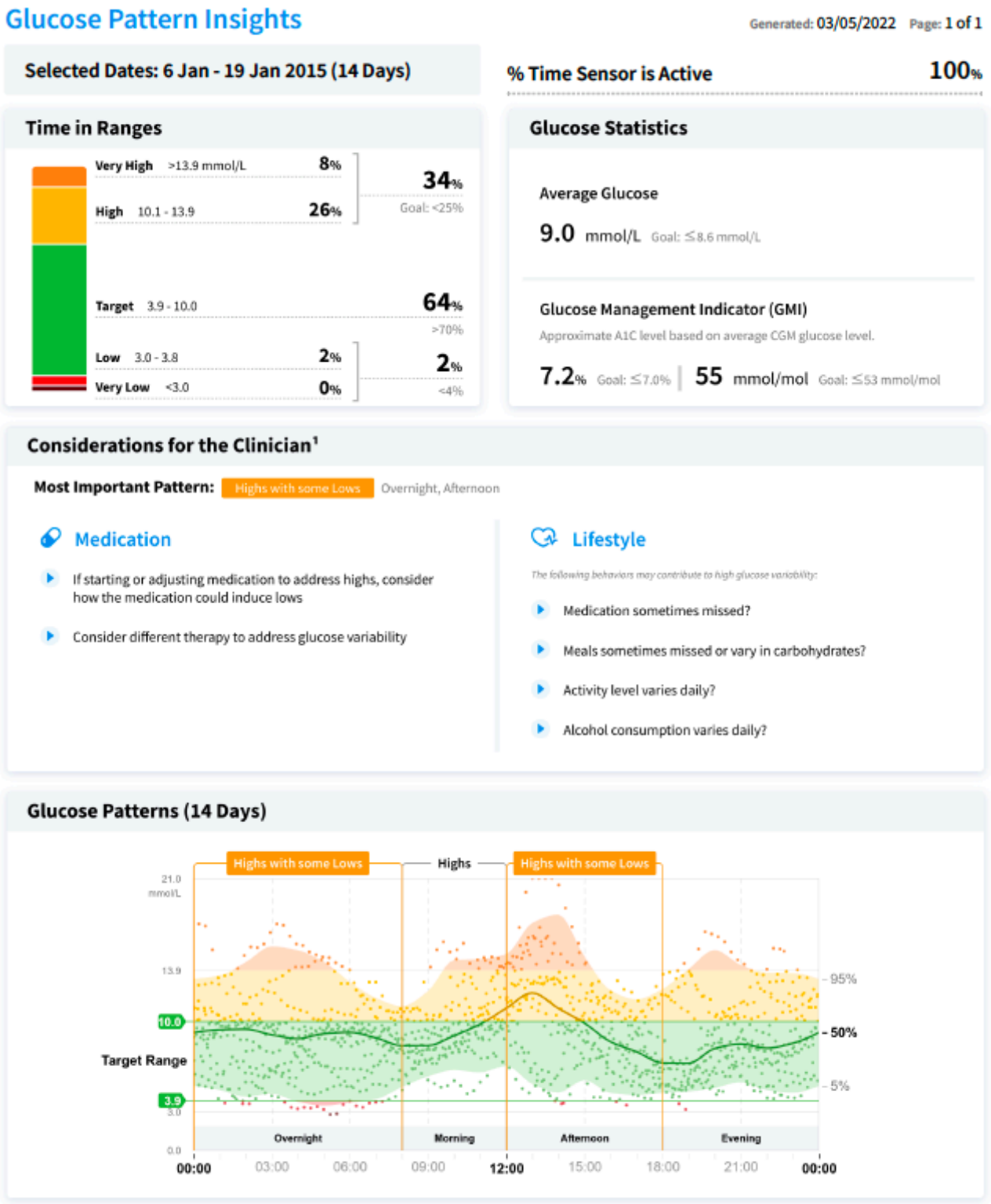
The Glucose Pattern Insights (GPI) report is divided into three parts

1. The glucose metrics (glucose pattern insights)
2. Considerations for the clinician
3. 14-day glucose patterns

While the GPI does not provide the complete Ambulatory Glucose Profile data, it does present the relevant information required for general practitioners to support people with diabetes using CGM/FGM to manage their glucose levels accordingly [3,5,8,11,12]. These include the following components:

(a) **Sensor capture data completeness** - provides information on the completeness of the reading period across a predefined serial time frame. The aim is for this to have at least 70% of the data captured across the entire 14-day time period [12].
(b) **Glucose management indicator (GMI)** – recent publications have indicated that 14 days of continuous glucose monitoring data can provide the GMI that is representative of the individual laboratory-based HbA1c values.
(c) **Time in range (TIR)** – increasingly this target glucose metric is being utilised to reflect whether an individualised TIR is being achieved for the glucose measures being monitored. The period of monitoring can vary but most commonly a 14-day timeframe is used. Typically in adults with type 1 diabetes, the range chosen is 3.9-10.0 mmol/L and the % TIR target is at least 70%, with less than 4% below the target range, and at most the remaining 25% above the target range. Usually, column graphs or pie graphs are utilised to report the TIR data [12].
(d) **Glucose patterns graph (14 days)** – a summary graph of glucose data presented over a 24 hour period, combining results from consecutive days and indicating hypoglycaemic and hyperglycaemic periods as well as glucose variability.

Figure 1: Example of a Glucose Pattern Insights (GPI) Report



Part 1: Glucose Pattern Insights (GPI):

- The **clinical data capture** should be at least 70% of a 14 day period. In this case, the active sensor data capture is 100%
- **Time in Range** (which is typically set at 3.9–10 mmol/L for type 1 diabetes – please see below) should be at least 70%. In this case it is 64%
- **Time below range** should be less than 4%. In this case it is 2%
- **Time above range** should be less than 25%. In this case it is 34%
- **Glucose management indicator (GMI)** is an estimate of HbA1c, which should be less than 7%. In this case it is 7.2%

Part 2: Clinical Considerations

The GPI identifies areas that require clinical considerations and provides the clinician with some points to consider discussing with the person with diabetes to improve glycaemic targets as well as glucose variability. In this case, adjustments can be made to increase time in range as well as lifestyle modifications to improve glycaemic variability.

Part 3: Glucose Patterns (14 days)

The glucose data are assembled across a 24 hour period, combining consecutive days' results into the one summary graph. The median line indicates that 50% of readings fall above the line and 50% of the glucose readings fall below the line. In order to reflect variation in data, the 25^{th} and 75^{th} centiles are included as shaded areas, as are the 5^{th} and 95^{th} centiles. In addition the Glucose Patterns graph shows the variability in glucose data, which can be improved by making adjustments to lifestyle factors (timing of meals, carbohydrate intake, exercise, alcohol intake etc.) as well as medications. Thus, the graph provides a graphical representation of data across a series of days, consolidated into one image.

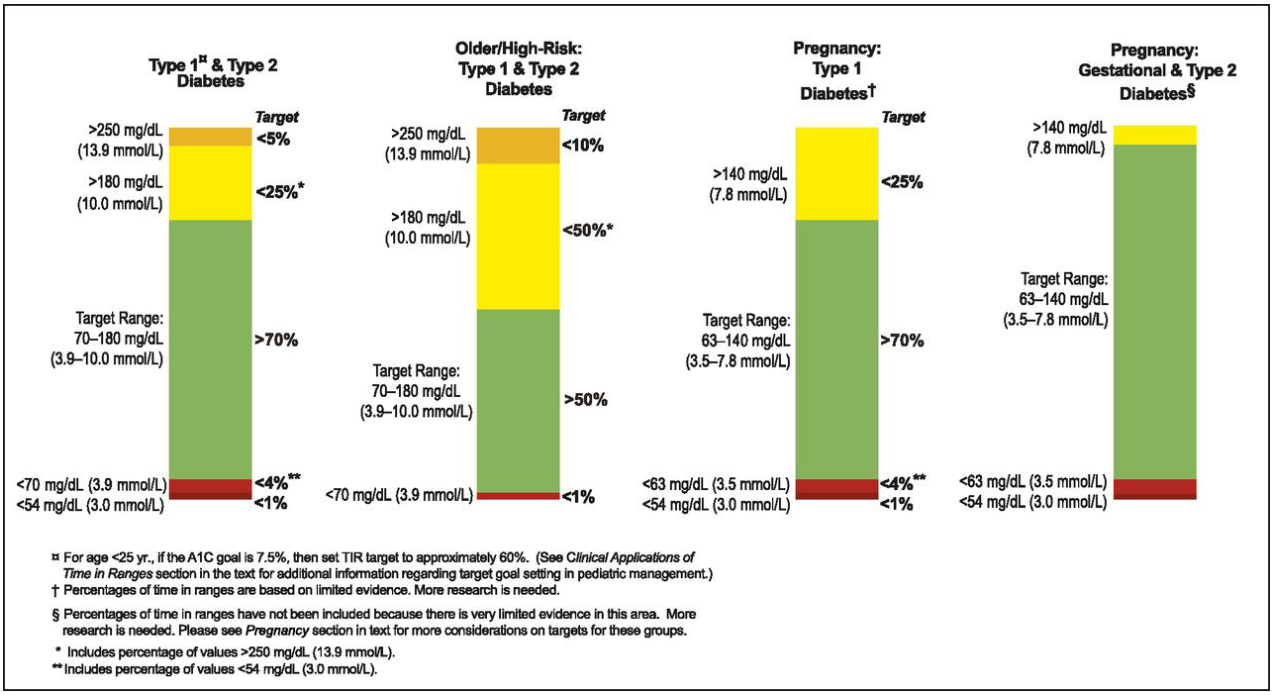
In this case, significant hyperglycaemic events are occurring during the afternoon and evening as well as overnight. There are some values in the hypoglycaemic range (below 3.9 mmol/L). The highest priority is always to address and prevent hypoglycaemia. In this case adjustments to insulin dosing to address the significant hyperglycaemia would need to be carefully done so that they do not increase time below range (particularly overnight).

In addition, glucose variability can be reduced by investigating lifestyle factors including carbohydrate intake, timing of or missed meals, missed medications, changes in physical activity or alcohol consumption.

The challenges with this type of reporting include the following: the data generated need to be near-complete to aid interpretation; timing of meals, in particular, may vary between days and thus contribute to variability in and across day summary data; within day variability may be diluted.

Recently, the International Consensus on Time in Range updated a number of clinical parameters, including time in range, as well as above and below range targets. Figure 2 below shows CGM-based targets for different diabetes populations [12].

Figure 2



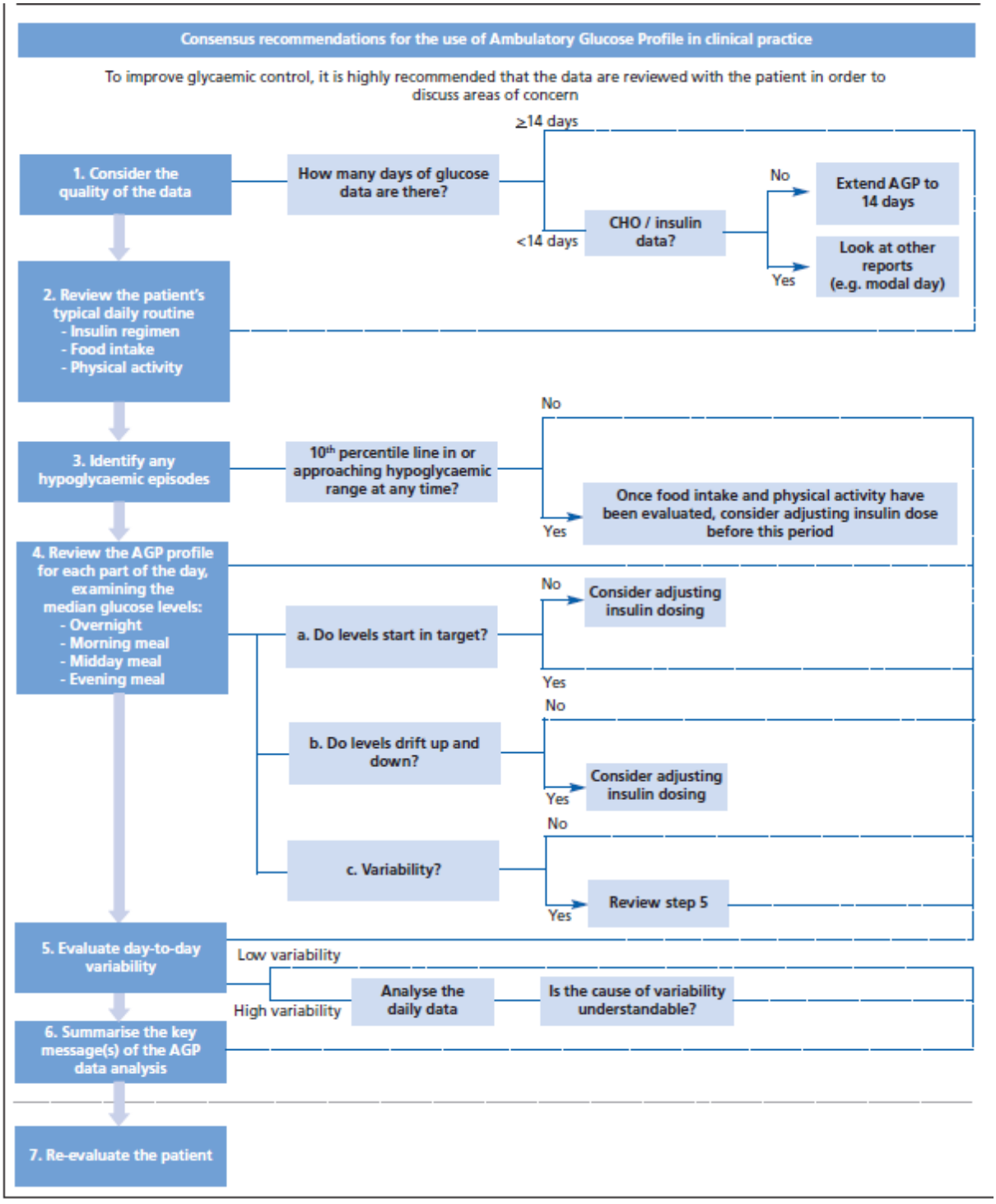
Practical Points:

1. In general for type 1 diabetes, a time in range of greater than 70% with a time below range of less than 4% and a time above range of less than 25% is recommended.

2. For older people or those at high risk or with hypoglycaemia unawareness, a time in range of greater than 50% with a time below range of less than 1% and a time above range of less than 50% is recommended.

An expert panel of diabetes specialists in Europe [13] developed a step-by-step approach to assist clinicians in analysing AGP reports in clinical practice (Figure 3). The group supported the view that the AGP can be an effective standard for the analysis of glucose data. The step-by-step approach is expected to improve glycaemic control and may help people with diabetes better understand and become more involved in managing their diabetes. The focus and priority should be preventing and managing hypoglycaemia, including nocturnal events.

Figure 3



References:

[1] Johnson SR, Holmes-Walker DJ, Chee M, Earnest A, Jones TW on behalf of the CGM Advisory Committee and Working Party and the ADDN Study Group. Universal Subsidized Continuous Glucose Monitoring Funding for Young People With Type 1 Diabetes: Uptake and Outcomes Over 2 Years, a Population-Based Study Diabetes Care. 2022; 45(2):391–397.

[2] Pease AJ, Andrikopoulos S, Abraham MB, Craig ME, Fenton B, Overland J, Price S, Simmons D, Ross GP. , access and recommendations regarding technologies for people living with type 1 diabetes: consensus statement of the ADS/ADEA/APEG/ADIPS Working Group. Med J Aust 2021; 215(10):443-446.

[3] International Consensus on Use of Continuous Glucose Monitoring. Danne T, Nimri R, Battelino T, Bergenstal RM, Close KL, DeVries JH, Garg S, Heinemann L, Hirsch I, Amiel SA, Beck R, Bosi E, Buckingham B, Cobelli C, Dassau E, Doyle FJ 3rd, Heller S, Hovorka R, Jia W, Jones T, Kordonouri O, Kovatchev B, Kowalski A, Laffel L, Maahs D, Murphy HR, Nørgaard K, Parkin CG, Renard E, Saboo B, Scharf M, Tamborlane WV, Weinzimer SA, Phillip M. Diabetes Care. 2017; 40(12):1631-1640.

[4] Brown SA, Basu A, Kovatchev BP. Beyond HbA1c: using continuous glucose monitoring metrics to enhance interpretation of treatment effect and improve clinical decision-making Diabet Med. 2019; 36(6):679-687.

[5] Petrie JR, Peters AL, Bergenstal RM, Holl RW, Fleming GA, Heinemann L. Improving the Clinical Value and Utility of CGM Systems: Issues and Recommendations: A Joint Statement of the European Association for the Study of Diabetes and the American Diabetes Association Diabetes Technology Working Group. Diabetes Care. 2017; 40(12):1614-1621.

[6] Kudva YC, Ahmann AJ, Bergenstal RM, Gavin JR 3rd, Kruger DF, Midyett LK, Miller E, Harris DR. Approach to Using Trend Arrows in the FreeStyle Libre Flash Glucose Monitoring Systems in Adults. J Endocr Soc. 2018; 2(12):1320-1337.

[7] Evans M, Cranston I, Bailey CJ. Ambulatory glucose profile (AGP): utility in UK clinical practice. Br J Diab 2017; 17(1):26-33.

[8] Bergenstal RM, Ahmann AJ, Bailey T, Beck RW, Bissen J, Buckingham B, Deeb L, Dolin RH, Garg SK, Goland R, Hirsch IB, Klonoff DC, Kruger DF, Matfin G, Mazze RS, Olson BA, Parkin C, Peters A, Powers MA, Rodriguez H, Southerland P, Strock ES, Tamborlane W, Wesley DM. Recommendations for standardizing glucose reporting and analysis to optimize clinical decision making in diabetes: the ambulatory glucose profile. J Diabetes Sci Technol. 2013; 7(2):562-578.

[9] Mazze R, Akkerman B, Mettner J. An overview of continuous glucose monitoring and the ambulatory glucose profile. Minn Med. 2011; 94(8):40-44.

[10] Mazze RS, Lucido D, Langer O, Hartmann K, Rodbard D. Ambulatory glucose profile: representation of verified self-monitored blood glucose data. Diabetes Care. 1987; 10(1):111-117.

[11] Grunberger G, Handelsman Y, Bloomgarden ZT, Fonseca VA, Garber AJ, Haas RA, Roberts VL, Umpierrez GE. American Association of Clinical Endocrinologists and American College of Endocrinology 2018 Position Statement on Integration of Insulin Pumps and Continuous Glucose Monitoring in Patients with Diabetes. Endocr Pract. 2018; 24(3):302-308.

[12] Battelino T, Danne T, Bergenstal RM, Amiel SA, Beck R, Biester T, Bosi E, Buckingham BA, Cefalu WT, Close KL, Cobelli C, Dassau E, DeVries JH, Donaghue KC, Dovc K, 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. 2019; 42(8):1593-1603.

[13] Matthaei S, Dealaiz R, Bosi E, Evans M, Geelhoed-Duijvestin N, Joubert M, Consensus recommendations for the use of Ambulatory Glucose Profile in clinical Practice. Br J Diabetes Vasc Dis. 2014; 14(4):153-157.