ORIGINAL ARTICLE

Nonadherence to potassium replacement protocol leads to prolonged management of diabetic ketoacidosis

Aleksandra Cieluch, Aleksandra Uruska, Bogusz Falkowski, Magdalena Błońska, Paweł Niedźwiecki, Karolina Balawajder, Aleksandra Araszkiewicz, Dorota Zozulińska-Ziółkiewicz

Department of Internal Medicine and Diabetology, Poznan University of Medical Sciences, Poznań, Poland

KEY WORDS

adherence, diabetic complications, diabetic ketoacidosis, type 1 diabetes mellitus

ABSTRACT

INTRODUCTION Diabetic ketoacidosis is a life-threatening condition that requires prompt management.

OBJECTIVES We aimed to assess the impact of adherence to potassium replacement protocol according to the guidelines of Diabetes Poland on the duration of diabetic ketoacidosis (DKA) treatment.

PATIENTS AND METHODS This retrospective analysis included 242 adults (median age, 27 years; range, 21–38 years). Nonadherence to potassium replacement protocol was assessed, along with the relationship between nonadherence and duration of DKA management. Nonadherence to the protocol was defined as too low or too high doses of potassium compared with the recommended potassium replacement protocol.

RESULTS The median duration of DKA treatment was longer in the nonadherent group than in the adherent group: 37 hours (interquartile range [IQR], 27–48) and 30 hours (IQR, 17–43), respectively ($P = 0.005$). Treatment duration correlated positively with nonadherence to potassium replacement protocol ($r = 0.18$; $P = 0.005$) and severity of DKA ($r = 0.52$; $P < 0.0001$). Stepwise multivariate linear regression analysis indicated nonadherence to the protocol ($\beta = 0.14$; $P = 0.02$) and severity of DKA ($\beta = 0.43$; $P < 0.0001$) as predictors of treatment duration, after adjustment for body mass index and age ($R^2 = 0.28$; $P < 0.0001$).

CONCLUSIONS Nonadherence to potassium replacement protocol leads to prolongation of DKA management. Medical staff should be educated about the benefits of potassium replacement and precision in potassium administration and dosing in patients with DKA.

Correspondence to:
Aleksandra Cieluch, MD, Department of Internal Medicine and Diabetology, Poznan University of Medical Sciences, ul. Mickiewicza 2, 60-834 Poznań, Poland, phone: +48 61 224 52 70, email: aleksandra.cieluch@o2.pl

Received: March 29, 2018.
Revision accepted: June 22, 2018.
Published online: July 11, 2018.
Conflict of interest: none declared.
Pol Arch Intern Med. 2018; 128 (7-8): 416-420
doi:10.20452/pamw.4293

INTRODUCTION Diabetic ketoacidosis (DKA) is an acute and life-threatening complication of diabetes mellitus. It results from absolute insulin deficiency and is accompanied by an increase in counterregulatory hormones (glucagon, catecholamines, cortisol, and growth hormone). DKA is a metabolic disorder, which encompasses hyperglycemia, metabolic acidosis, and the production of ketone bodies.[1,2] An important prognostic indicator is the timing of its management as the longer the patient remains in DKA, the higher the health risks of acidosis and hyperglycemia. The duration of the acute phase of DKA appears to be crucial in the prognosis of patients.

DKA occurs mostly in type 1 diabetes, but is also possible in type 2 diabetes, especially with concomitant infection, trauma, cardiovascular stress, or other medical emergencies.[3] Decompensation of diabetes is often caused by poor management, despite the fact that there are numerous voluntary organizations and educational programs that provide support for patients with diabetes.[4,5] The mortality rate of DKA has fallen significantly over the years and is currently less than 1%. This is due to improved therapy during the episodes of DKA.[6]

Patients with DKA almost always present with potassium deficiency.[7,8] This is caused by osmotic diuresis, excretion of potassium ketoacid

TABLE 1 Recommended doses of potassium chloride (KCl) according to 2017 Polish Diabetes Guidelines[28]

Blood potassium concentration, mmol/l	Recommended KCl supplementation[a], mmol/h
>5.5	Do not administer KCl.[b]
5.0–5.5	5–10
4–5	10–15
3–4	15–20
<3	25 after stopping insulin infusion.

a Central venous line or 2 peripheral veins should be used in the case of potassium supplementation over 15 mmol/h.

b If the serum potassium level is higher than 5.5 mmol/l, the measurement should be performed after 2 hours, and after normalization, every 4 hours.

anion salts, secondary hyperaldosteronism, and, to a lesser extent, gastrointestinal loss. However, plasma potassium concentrations are often within the reference ranges or even elevated.[9] In healthy adults, the approximate total body content of potassium is 50 mEq/kg, and 98% is observed intracellularly.[10] Insulin administration activates Na^+/K^+-ATPase, causing active potassium uptake and thus generating serum hypokalemia. During DKA treatment, the serum potassium level decreases rapidly and can result in life-threatening complications, such as bradycardia, ventricular fibrillation, or acute respiratory failure,[11-13] even despite potassium replacement. To prevent these complications, a potassium supplementation algorithm has been developed in Poland and other countries.[14-16] Importantly, in the United Kingdom and United States, there are different indications for the equalization of potassium deficiency in DKA. Due to the lack of firm evidence base, there are discrepancies in protocols for managing DKA.[17]

Although there are clear guidelines for the management of DKA, nonadherence to DKA treatment protocols is highly prevalent, which is considered the major reason for therapy failure.[18] This study aimed to assess the impact of adherence to potassium replacement protocol according to the guidelines of Diabetes Poland on the duration of DKA treatment.

PATIENTS AND METHODS

Study population This retrospective analysis was conducted among 302 patients with diabetes mellitus referred to the Department of Internal Medicine and Diabetology at the Poznan University of Medical Sciences (Poznań, Poland) between the years 2012 and 2015 with a preliminary diagnosis of DKA. The inclusion criterion was age above 18 years. Patients who did not meet the diagnostic criteria for DKA, those who required intensive care, those with gestational DKA, and those who died due to DKA were not eligible for the study. A total of 60 patients were excluded, resulting in the final study sample of 242 patients.

Data collection Patients' data were collected between January 2012 and December 2015 and included anthropometric measures (body mass, height, body mass index [BMI], and waist circumference), age, and sex. Blood tests included the measurement of venous blood gas (pH, HCO_3^-, base excess [BE]), metabolic parameters (glycated hemoglobin and glucose levels), electrolytes (potassium and sodium), anion gap, and creatinine. All parameters were measured in plasma using standard laboratory methods. The glucose level was measured every hour in capillary blood. The levels of sodium, potassium, and blood gases were measured every 4 hours in venous blood.

The volumes of transfused fluids (0.9% sodium chloride, 5% glucose) during DKA therapy were noted and presented as combined results. The total duration of DKA therapy was defined as the number of hours between admission and achievement of normal blood gas parameters.

Laboratory criteria for diagnosis of diabetic ketoacidosis The diagnostic criteria for DKA were as follows: glucose level over 250 mg/dl (13.9 mmol/l), pH below 7.3, serum HCO_3^- below 15 mmol/l, anion gap over 12 mmol/l, and the presence of ketone bodies in urine. Anion gap was calculated using the formula: Na^+ (mmol/l) – [Cl^- (mmol/l) + HCO_3^- (mmol/l)], where Na^+ stands for sodium; Cl^-, chloride; and HCO_3^-, bicarbonate ions in blood. To diagnose DKA, every criterion had to be met. The severity of DKA was assessed as mild if pH was higher than 7.24 and as moderate or severe if pH was lower than 7.24.

Potasssium replacement protocol and nonadherence The protocol of potassium supplementation was according to the 2016 guidelines of Diabetes Poland.[14] Plasma potassium levels were measured every 4 hours. Nonadherence to the protocol was defined as too low or too high doses of potassium compared with those recommended by Diabetes Poland in the potassium replacement protocol for DKA treatment. Patients were divided into 2 groups: nonadherent and adherent to the potassium replacement protocol. A single case of nonadherence to the protocol was enough for the patient to be classified in the nonadherent group. Adequate potassium replacement was evaluated after every potassium measurement. Adequate potassium doses depended on the actual concentration of potassium in blood according to TABLE 1.[14]

Ethical considerations The study protocol was approved by the local ethics committee (reference no.: 487/12) and followed the Declaration of Helsinki on biomedical research involving human subjects.

Statistical analyses Statistical analysis was conducted using the commercially available software, STATISTICA V12.5 PL (Statsoft, Tusla, Oklahoma,

TABLE 2 Baseline characteristics of groups with nonadherence and adherence to potassium replacement protocol

Parameter	Nonadherent group (n = 173)	Adherent group (n = 69)	*P* value
Age, y	27 (21–38)	27 (21–37)	0.9
Sex, male/female, n	90/83	31/38	0.3[a]
Smoking, n (%)	66 (38.2)	20 (29.0)	0.2[a]
HbA_{1c}, mmol/l	100 (86–120)	105 (86–122)	0.4
HbA_{1c}, %	11.3 (10.0–13.1)	11.8 (10.0–13.3)	0.4
BMI, kg/m^2	22.24 (20.07–24.57)	21.78 (20.08–23.22)	0.2
Glucose, mmol/l	21.7 (14.8–27.4)	19.0 (15.0–23.9)	0.2
pH	7.26 (7.11–7.34)	7.32 (7.16–7.38)	0.01
HCO_3^-, mmol/l	11.9 (8.1–17.0)	15.6 (9.0–19.6)	0.01
BE, mmol/l	–16.7 (–23.3 to –9.6)	–9.4 (–21.5 to –6.4)	0.009
Severity of DKA, mild / moderate and severe, n (%)	92 (53.2) / 81 (46.8)	46 (66.7) / 23 (33.3)	0.08[a]
Sodium, mmol/l	133 (131–136)	133 (131–137)	0.7
Potassium, mmol/l	4.35 (3.95–4.99)	4.22 (3.96–4.74)	0.2
Creatinine, μmol/l	76.9 (61.9–100.8)	76.9 (62.8–96.4)	0.6

Data are presented as median (interquartile range) unless otherwise indicated. A *P* value of less than 0.05 was considered significant.

a χ^2 test with Yates correction; Mann–Whitney in the remaining cases

Abbreviations: BE, base excess; BMI, body mass index; DKA, diabetic ketoacidosis; HbA_{1c}, glycated hemoglobin A_{1c}

TABLE 3 Posttreatment characteristics of groups with nonadherence and adherence to potassium replacement protocol

Parameter	Nonadherent group (n = 173)	Adherent group (n = 69)	*P* value
Duration of DKA therapy, h	37 (27–48)	30 (17–43)	0.005
Volume of transfused 0.9% sodium chloride, ml	10 137.5 (7250.0–12 645.0)	8500 (5000–11 000)	0.005
Volume of transfused 5% glucose, ml	2900 (1800–4100)	2400 (1100–3800)	0.07
Amount of transfused potassium, mmol	485 (300–655)	380 (190–585)	0.04

Data are presented as median (interquartile range). A *P* value of less than 0.05 was considered significant.

Abbreviations: see TABLE 2

United States). The results were presented as median and interquartile range (IQR). Normal distribution of data was verified using the Shapiro–Wilk test. However, due to nonnormal distribution, the Mann–Whitney test was performed to compare the median results of laboratory tests in the study groups. The χ^2 test was used to assess differences in the nominal results between groups. Correlations between duration of DKA treatment and laboratory findings were assessed using the Spearman rank correlation analysis. A *P* value of less than 0.05 was considered significant. We assessed variables that correlated with the duration of DKA therapy and included them in a stepwise multivariate linear regression model for further analyses.

RESULTS Nonadherence to the potassium replacement protocol was observed in 173 patients (71%). There were no significant differences in age or sex between groups (TABLE 2). The median (IQR) duration of DKA therapy was significantly longer in the nonadherent group than in the adherent one (TABLE 3). The volumes of transfused sodium chloride and potassium chloride were also significantly different between groups, with higher volumes transfused in the nonadherent group in comparison with the adherent group (TABLE 3). We observed significant differences between groups in blood gas parameters at baseline (TABLE 2). Patients in the nonadherent group were characterized by worse blood gas results on admission in comparison with the adherent group. They showed lower pH and HCO_3^- and higher BE. In both groups, mild DKA was more common than moderate and severe DKA. However, in the nonadherent group, the difference in this prevalence was significantly lower and moderate and severe DKA was more common than in the adherent group.

There were no significant differences in sodium and potassium concentrations on admission between groups. Duration of DKA therapy correlated positively with nonadherence to potassium replacement protocol, severity of DKA, and BMI. On the other hand, negative correlations were found for blood gases: pH, HCO_3^-, and BE. Data are presented in TABLE 4. The stepwise multivariate linear regression analysis indicated nonadherence to potassium replacement protocol and severity of DKA as predictors of DKA treatment duration, after adjustment for BMI and age (TABLE 5).

DISCUSSION DKA is an acute, life-threatening condition. Its duration is critical, as it affects the patient's prognosis. Despite recommendations of Polish and international societies, nonadherence to DKA treatment protocols is widely observed.[18] To our knowledge, our study is the first to focus particularly on nonadherence to potassium replacement protocol in the treatment of DKA. We showed that the nonadherence affects the management of DKA by prolonging its duration and, consequently, the length of hospital stay.[13]

Because DKA is a hyperglycemic state associated with a significant risk of death,[19] it is essential that patients are managed in the fastest possible way with a safe and appropriate treatment. To meet this goal, scientific societies worldwide have developed recommendations and step-by-step algorithms for DKA therapy.[20,21] They are clear, easy to follow, and evidence based. Literature data confirm the benefits of using appropriate algorithms in DKA treatment.[22,23] However, medical staff does not always follow the guidelines.

The use of insulin therapy in DKA treatment results in a shift of intracellular potassium and

TABLE 4 Correlations between laboratory parameters and duration of diabetic ketoacidosis treatment

Parameter	*r*	*P* value
Nonadherence to potassium replacement protocol	0.18	0.005
Age	–0.09	0.2
Type 1 diabetes duration	0.007	0.9
Glycated hemoglobin	0.07	0.3
BMI	0.17	0.01
Glucose	0.10	0.1
pH	–0.59	<0.0001
HCO_3^-	–0.57	<0.0001
BE	–0.61	<0.0001
Severity of DKA	0.52	<0.0001
Sodium	–0.07	0.3
Potassium	0.07	0.3
Creatinine	0.07	0.3

Volumes of transfused fluids were excluded because of their correlation with treatment duration. A *P* value of less than 0.05 was considered significant.

Abbreviations: see TABLES 1 and 2

TABLE 5 Predictors of diabetic ketoacidosis treatment duration in linear regression analysis with treatment duration as a dependent variable

Predictor	Multivariate regression analysis	
	β (95% CI)	*P* value
Nonadherence to potassium replacement protocol	0.14 (0.02–0.25)	0.02
BMI	0.11 (–0.01 to 0.22)	0.07
Severity of DKA	0.43 (0.32–0.54)	<0.0001
Male sex	–0.21 (–0.32 to –0.09)	0.0004
Age	–0.03 (–0.15 to 0.08)	0.59

Model performance: $R^2 = 0.28$; $P < 0.0001$

Abbreviations: see TABLES 1 and 2

TABLE 6 Types of nonadherence to potassium replacement protocol in the study

Type of nonadherence	Causes and circumstances
Potassium dose too low	• Previous dose was repeated regardless of the blood potassium level. • Potassium was administered shortly before the measurement of potassium concentration. • The dose administered by the physician was too low without any clear cause.
Potassium dose too high	• Previous dose was repeated regardless of the blood potassium level. • Potassium was administered shortly before the measurement of potassium concentration. • The dose administered by the physician was too high without any clear cause.
Missed potassium dose	• Mainly not administered to patients by oversight • Administration sometimes terminated prematurely

a decrease in plasma potassium levels, causing hypokalemia. This phenomenon can be caused both by high doses of insulin and its prolonged intravenous infusions.[24] It is critical to eliminate any potential potassium deficiency through parenteral supplementation to prevent serious complications, such as arrhythmia. Therefore, continuous monitoring of blood potassium levels and its replacement should be conducted as per the mandatory protocol.

One of the components of DKA treatment is to provide adequate amounts of potassium. The recommendations strictly determine the amount of potassium that should be supplemented depending on blood potassium levels. The DKA management protocol is designed to facilitate clinical practice and help clinicians avoid errors. Our analysis showed that proper potassium replacement is crucial in the therapeutic process as it affects duration of DKA management. In our study, the treatment duration in the nonadherent group was significantly longer compared with the adherent group. Interestingly, the volumes of transfused sodium and potassium chloride in the nonadherent group were significantly higher than in the adherent group. Therefore, our study confirms that nonadherence to potassium replacement protocol is harmful in that it increases the duration of DKA treatment, thus exposing patients to life-threatening complications. It is thus crucial to follow current treatment protocols, including potassium replacement, when managing patients with DKA. This will help avoid treatment errors and prolonged hospital stays.

Another issue is the reason for nonadherence. According to Singh et al,[25] young doctors managing patients with DKA make mistakes in their practice that increase morbidity and mortality among patients. The main mistakes include delays in implementing individual parts of the protocol, administration of an insufficient volume of fluids, and too low a dose of potassium.[25] The types of nonadherence observed in our study are listed in TABLE 6.

Evans et al[26] compared 2 cohorts of patients: one treated according to the protocol recommended by the American Diabetes Association and the other not treated in line with the guidelines. However, the authors introduced a few changes to the protocol, for example, they started replacement at an upper limit of potassium level of 5.2 mEq/l instead of 5 mEq/l. They compared the groups before and after the introduction of the protocol. The outcomes included duration of DKA treatment, time to intravenous fluid administration, and time to potassium replacement. Patients treated according to the old protocol (5 mEq/l) had a longer duration of DKA treatment and time to the first potassium replacement, although the differences were not significant. Additionally, the authors evaluated the outcomes only among patients treated after the introduction of the modified protocol (5.2 mEq/l) because only a few patients were not treated according to this protocol. The cohort managed with the changed protocol had a shorter duration of DKA therapy and time to the first potassium replacement. The authors suggested that their protocol may improve treatment outcomes

of patients with DKA. They compared time to the first potassium replacement, but there were no data on the volume of transfused potassium. It is unknown whether the groups differed in potassium doses and how this might have affected the duration of treatment.

Bull et al[27] observed that the available recommendations are not ideal for effective treatment of patients with DKA. They highlighted the fact that the proposed guidelines do not focus on all aspects of DKA and that the suggested regimens are not mandatory. They compared 2 cohorts of patients before and after the introduction of a mandatory DKA treatment protocol covering all components of the required therapy. Patients who were treated according to the mandatory protocol were characterized by shorter hospital and intensive care unit stays, as well as a shorter duration of DKA therapy. The authors confirmed that compliance with the mandatory protocol provides an opportunity for a successful treatment of DKA.

In conclusion, nonadherence to potassium replacement protocol leads to prolonged DKA management. To our knowledge, this is the first study showing the relationship between adherence to potassium replacement and duration of DKA management in patients with diabetes. One of the primary goals of DKA treatment is to maintain normal electrolyte levels. Our study showed that this is extremely important not only for prevention of arrhythmia or cerebral edema, but also for a faster resolution of this life-threatening complication in patients with diabetes.

CONTRIBUTION STATEMENT AC and MB collected the data, wrote the manuscript, and discussed the results. AU collected the data, performed statistical analysis, and discussed the results. BF collected the data, performed statistical analysis, wrote the manuscript, and discussed the results. PN, KB, and AA collected the data and discussed the results. DZ-Z designed the study and discussed the results. All authors contributed to interpretation of the data, reviewed the manuscript, and approved the final version of the manuscript before submission.

REFERENCES

1 Raghupathy P. Diabetic ketoacidosis in children and adolescents. Indian J Endocrinol Metab. 2015; 19: S55-57.

2 Schwab TM, Hendey GW, Soliz TC. Screening for ketonemia in patients with diabetes. Ann Emerg Med. 1999; 34: 342-346.

3 Kitabchi AE, Umpierrez GE, Miles JM, Fisher JN. Hyperglycemic crises in adult patients with diabetes. Diabetes Care. 2009; 32: 1335-1343.

4 Portillo MC, Kennedy A, Todorova E, et al. Interventions and working relationships of voluntary organisations for diabetes self-management: A cross-national study. Int J Nurs Stud. 2017; 70: 58-70.

5 Srulovici E, Key C, Rotem M, et al. Diabetes Conversation Map™ and health outcomes: A systematic literature review. Int J Nurs Stud. 2017; 70: 99-109.

6 Nyenwe EA, Kitabchi AE. The evolution of diabetic ketoacidosis: An update of its etiology, pathogenesis and management. Metabolism. 2016; 65: 507-521.

7 Wong B, Cheng A, Yu C, Goguen J. Examining the "Killer K" of diabetic ketoacidosis at a tertiary care hospital: an exploratory study. Can J Diabetes. 2016; 40: 204-209.

8 Usman A. Initial potassium replacement in diabetic ketoacidosis: the unnoticed area of gap. Front Endocrinol (Lausanne). 2018; 9: 109.

9 Arora S, Cheng D, Wyler B, Menchine M. Prevalence of hypokalemia in ED patients with diabetic ketoacidosis. Am J Emerg Med. 2012; 30: 481-484.

10 Murthy K, Harrington JT, Siegel RD. Profound hypokalemia in diabetic ketoacidosis: a therapeutic challenge. Endocr Pract. 2005; 11: 331-334.

11 Holler JW. Potassium deficiency occurring during the treatment of diabetic acidosis. J Am Med Assoc. 1946; 131: 1186-1189.

12 Gandhi M, Suvarna TT. Cardiovascular complications in diabetic ketoacidosis. Int J Diab Dev Countries. 1995; 15: 132-133.

13 Talebi S, Ghobadi F, Cacacho A, et al. Looking at diabetic ketoacidosis through electrocardiogram window! Am J Emerg Med. 2016; 34: 263-265.

14 Araszkiewicz A, Bandurska-Stankiewicz E, Budzynski A, et al. 2016 Guidelines on the management of diabetic patients. A position of Diabetes Poland. Clin Diabetol. 2016; 5: A1-A73.

15 American Diabetes Association. Standards of medical Care in Diabetes – 2016: Summary of Revisions. Diabetes Care. 2016; 39: S99-104.

16 Savage MW, Dhatariya KK, Kilvert A, et al. Joint British Diabetes Societies guideline for the management of diabetic ketoacidosis. Diabet Med. 2011; 28: 508-515.

17 Dhatariya KK, Vellanki P. Treatment of diabetic jetoacidosis (DKA)/hyperglycemic hyperosmolar state (HHS): novel advances in the management of hyperglycemic crises (UK versus USA). Curr Diab Rep. 2017; 17: 33.

18 Jervis A, Champion S, Figg G, et al. Prevalence of diabetes ketoacidosis rises and still no strict treatment adherence. Curr Diabetes Rev. 2013; 9: 54-61.

19 Azevedo LC, Choi H, Simmonds K, et al. Incidence and long-term outcomes of critically ill adult patients with moderate-to-severe diabetic ketoacidosis: retrospective matched cohort study. J Crit Care. 2014; 29: 971-977.

20 Bogun M, Inzucchi SE. Inpatient management of diabetes and hyperglycemia. Clin Ther. 2013; 35: 724-733.

21 Lee MH, Calder GL, Santamaria JD, MacIsaac RJ. Diabetic ketoacidosis in adult patients: an audit of factors influencing time to normalisation of metabolic parameters. Intern Med J. 2018; 48: 529-534.

22 Maghrabi AH, Hamoudeh E, Hassan T, et al. Safety and Efficacy of an Algorithm-Based Protocol in the Management of Diabetic Ketoacidosis. Endocr Pract. 2012; 18: 842-846.

23 Ilag LL, Kronick S, Ernst RD, et al. Impact of a critical pathway on inpatient management of diabetic ketoacidosis. Diabetes Res Clin Pract. 2003; 62: 23-32.

24 Carlotti AP, St George-Hyslop C, Bohn D, Halperin ML. Hypokalemia during treatment of diabetic ketoacidosis: clinical evidence for an aldosterone-like action of insulin. J. Pediatr. 2013; 163: 207-212.

25 Singh RK, Perros P, Frier BM. Hospital management of diabetic ketoacidosis: are clinical guidelines implemented effectively? Diabet Med. 1997; 14: 482-486.

26 Evans KJ, Thompson J, Spratt SE, et al. The implementation and evaluation of an evidence-based protocol to treat diabetic ketoacidosis: a quality improvement study. Adv Emerg Nurs J. 2014; 36: 189-198.

27 Bull SV, Douglas IS, Foster M, Albert RK. Mandatory protocol for treating adult patients with diabetic ketoacidosis decreases intensive care unit and hospital lengths of stay: results of a nonrandomized trial. Crit Care Med. 2007; 35: 41-46.

28 Araszkiewicz A, Bandurska-Stankiewicz E, Budzynski A, et al. 2017 Guidelines on the management of diabetic patients. A position of Diabetes Poland. Clin Diabetol. 2017; 6: A1-A80.