



ANALYSIS OF MY BLOOD SUGAR LEVELS: FROM LIVED EXPERIENCE TO A TYPE 2 DIABETES MANAGEMENT HINTS

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ABSTRACT

This article presents the researcher's experience in managing his blood sugar levels for a period of four years since he was diagnosed with Type 2 (adult-onset) diabetes with a glucose measurement level of 24mmol/L on 18 September 2018 at Health Gate Pharmacy in Mutare, Zimbabwe. A person with diabetes needs to monitor and control his/her blood sugar level by regularly testing blood sugar levels, analysing the data, and interpreting the results. The literature reveals that before meals, the blood sugar level for adults should be from 5.0mmol/L to 7.2mmol/L . Two hours after meals, the blood sugar level should be less than 10mmol/L . At bedtime, the normal blood sugar level should be between 5.0mmol/L and 8.3mmol/L . The researcher used the SD Code Free Blood Sugar Monitoring System to record blood sugar levels for 50 randomly selected days from 23 October 2020 to 31 August 2022 at 8 am before taking meals. The average blood sugar level was 6.0mmol/L with minimum and maximum blood sugar levels of 4.6mmol/L and 7.0mmol/L respectively. The results indicate that the blood sugar level was stable during the examined period. All blood sugar level data points except one were between 5.0mmol/L and 7.2mmol/L . A level of self-control is important to monitor and prevent Type 2 diabetes in adults. The researcher's experience shows that a person with Type 2 diabetes can monitor and control it to complete remission. The study used the experience to develop Type 2 diabetes monitoring hints that could help others to monitor and control the ailment.

KEYWORDS: Diabetes Type 2, Diabetes Monitoring Framework, Blood sugar level, lived experience **JEL Classification:** I, I0, I00, I000.

INTRODUCTION

Diabetes remains one of the most common and dangerous ailments (Zee Media Bureau, 2022) in the world. There is no known cure for diabetes. In Zimbabwe, 10 in every 100 people are diabetic (MHCC, 2020). Mutowo, *et al.* (2015) noted a significant increase in the prevalence of diabetes in the past three decades in Zimbabwe. Little is being done to conscientise people about the dangers associated with diabetes. Dansinger (2023) stated that 29 million people have Type 2 diabetes in the United States. The blood sugar level is commonly measured in millimoles of sugar per litre (mmol/L) (Mayo Clinic Staff, 2021). The types of diabetes that can affect people are Type 1, Type 2, gestational diabetes (Washington, 2023; Punthakee, Goldenberg, & Katz, 2018), and other specific types of diabetes (American Diabetes Association, 2011). With Type 1 diabetes, the pancreas fails to produce insulin for the body. With Type 2 diabetes, the cells of the body resist absorbing insulin (insulin resistance). Type 2 diabetes was known as adult-onset diabetes (Dansinger, 2023). According to

Washington (2023), diabetes affects the kidneys, nervous system, blood pressure, and blood vessels. Diabetes affects the vision, kidneys, liver, and heart of a person with diabetes (Zee Media Bureau, 2022; Sneha & Gangil, 2019).

According to Mayo Clinic Staff (2021), the common symptoms of diabetes are losing weight, feeling tired, urinating frequently, and increasing thirst. The researcher started experiencing dry lips and urinating more frequently than before on 18 September 2018. The researcher was gaining more weight with a body weight of 98 kilograms contrary to one of the symptoms of diabetes stated by Mayo Clinic Staff (2021). The researcher went for a blood sugar level test at Mutare Health Gate Pharmacy. The researcher under the supervision of diabetes practitioners started taking medication, a healthy diet, and light physical activities and exercises. After the blood sugar level was controlled to acceptable levels, the physician slightly increased the quantity of food for the researcher. The researcher was

later allowed to drink tea without sugar with 2% fat milk and four slices of brown bread spread with peanut butter in the morning. The success was through the assistance of the physicians (DB1, DB2, and DB3) who volunteered (Murairwa, 2015) to help the researcher recover from Type 2 diabetes through education, medication, and a controlled healthy diet. The researcher religiously followed the physicians' dos and don'ts and recovered from Type 2 diabetes. The researcher under the supervision of volunteered (Murairwa, 2015) physicians, a healthy diet, medication, and light physical activities and exercises managed Type 2 diabetes to complete remission. The objectives of this research were to assess the blood sugar levels, determine the variation of the blood sugar levels, and establish hints for managing Type 2 diabetes. The research hypothesised that the strategies implemented by the researcher to manage hyperglycemia were effective.

LITERATURE REVIEW

The common diabetes symptoms are going to the toilet more frequently, being thirsty, feeling more tired than usual, losing weight without trying to, genital itching or thrush, cuts and wounds taking longer to heal, blurred eyesight, and increased hunger. These are referred to as the 4 Ts - toilet, thirsty, thinner, and tiredness. According to Mayo Clinic staff (2022), people should watch for low blood sugar levels symptoms such as sweating, shakiness, weakness, hunger, dizziness, headache, blurred vision, heart palpitations, irritability, slurred speech, drowsiness, confusion, fainting, and seizures. A person's blood sugar level of less than 7.8 mmol/L indicates a normal and acceptable blood sugar level; from 7.8 mmol/L to 11.0 mmol/L indicates a pre-diabetic level; and more than 11.0 mmol/L after two hours of taking a meal indicates a diabetic condition (Mayo Clinic staff, 2022). The blood sugar control levels by Sandeep and Dhaliwal (2022) are presented in Table 1.

Table 1: Blood Sugar Control Measurement Levels.

Time	Mmol/L	Age range
Before meals	5.0 – 7.2	Adults
	5.0 – 7.2	13 – 19
	5.0 – 10.0	6 – 12
	5.5 – 10.0	< 6
1 - 2 hours after meals	< 10	Adults
At bedtime	5.0 – 8.3	Adults
	5.0 – 8.3	13 – 19
	5.5 – 10.0	6 – 12
	6.1 – 11.1	< 6

Table 1 shows the acceptable normal ranges of blood sugar levels. Dansinger (2023b) stated that a normal fasting blood sugar level should be less than 5.6 mmol/L. Dansinger (2023b) also found that a fasting blood sugar level of between 5.6 mmol/L and 7.0 mmol/L indicates an impaired fasting sugar level and that above 7.0 mmol/L indicates diabetes. A glycated haemoglobin (HbA_{1c}) measurement of at least 6.5% shows the presence of diabetes (The diaTribe Foundation, 2023). The HbA_{1c} is used to diagnose, control, or confirm Type 2 diabetes by measuring the amount of sugar that has been in your blood over some past months. Very high or low diabetes levels can lead to other diseases such as kidney or heart ailments, and damaged eyes among others (Zee Media

Bureau, 2022). Zee Media Bureau (2022) listed artificial sweeteners, coffee, lack of sleep, skipping breakfast, dawn phenomenon, gum disease, and dehydration as the causes of hyperglycemia in adult people. The different foods that are high in fiber that can assist in managing Type 2 diabetes are vegetables, fruits, legumes, and whole grains. The traditional therapies with anti-diabetes include Okra, Ginger, Aloe Vera, and Cinnamon (DCU, 2023). A person can drink Guava leaf tea to prevent Type 2 diabetes spikes and improve the ailment's symptoms (Olsen, 2023). The FA (2023) experiences with persons with Type 2 diabetes are presented in Table 2.

Table 2: Type 2 Diabetes Experience Statistics.

Category	Type 2	Prediabetes
Improved Symptoms	94%	93%
Symptoms Resolved Completely	40%	48%
Complete Remission	Nearly 50%	-

Table 2 shows that persons with Type 2 diabetes can completely recover from the ailment since nearly 50% of the participants who joined the FA (2023) with Type 2 diabetes had complete remission. The literature classifications of diabetes include Type 1, Type 2,

Gestational, and Others (Dansinger, 2023; Punthakee, Goldenberg, & Katz, 2018) excluding the prediabetes stage. However, the road to Type 2 diabetes passes through the prediabetes stage (CDC, 2023) as shown in Figure 1.



Figure 1: Road to Type 2 Diabetes.

Figure 1 shows that the prevention of Type 2 diabetes should be done at normal and prediabetes stages. The global prevalence of Type 2 diabetes in adults was 536.6 million people which is equivalent to 10.50% of the world's adult people in 2021 (Sun, et al., 2021). The prevalence rate is projected to increase to 12.20% in 2045 which will be about 728.2 million adult people (Sun, et al., 2021).

METHODOLOGY

Type of study: This research is a Mixed Methods study on the researcher's blood sugar variation after being diagnosed with Type 2 diabetes on 18 September 2018 at Mutare Health Gate pharmacy. The research collected both qualitative and quantitative data for analysis from diet and health practitioners. Type 2 diabetes was also confirmed by the general practitioner (GP1) at Second Street Medical Clinic in Mutare, Zimbabwe.

Population, sample, and data: The longitudinal repeated continuous data were collected at random intervals for this research from 23 October 2020 to 20 May 2022, a total of 574 days. The researcher also collected qualitative data from seven medical experts; the pharmacist, three general practitioners (family doctors) {GP1, GP2, & GP3}, and three diabetologists (DB1, DB2, and DB3). A large sample of 45 days was selected to test the researcher's blood sugar level at 8 am before taking meals. Thus, the sample size used in this study is 7.84% of the total population. The researcher also considered five blood sugar level data collected on 28 September 2018, the day the Type 2 diabetes was diagnosed.

Data collection method: The SD Blood Glucose Monitoring System (SD BGMS) was used to test the researcher's blood sugar levels on 45 selected days. The Unit of measurement was millimoles of sugar per litre (mmol/L). The researcher tested and recorded his blood sugar level every morning at 8 am before taking meals. The normal blood sugar level control range was 5.0 mmol/L to 7.2 mmol/L by Sandeep and Dhaliwal (2022). The researcher started collecting the research data after two years of taking diabetes medication and had been cleared to stop taking it by the diabetologist 3 (DB3). The researcher collected 45 data points on randomly selected days from 23 October 2020 to 31 August 2022.

Data collection instruments: The researcher used the SD Blood Glucose Monitoring System (SD BGMS), Self-Test Diary (STD), and a pen to test his blood sugar level and record the data for this research.

Data analysis tools: The research applied the scatter plot to analyse the distribution of the blood sugar level data in Statistical Package for the Social Sciences (SPSS). Descriptive statistics were applied to measure the variability of the blood sugar levels and compute the Individual and Moving Range chart (I-MR). The research applied Sandeep and Dhaliwal's (2022) benchmarks to fit the I-MR chart to determine the stability and predictability of the variations in the researcher's blood sugar levels. The Lower Control Limits (LCL) and Upper Control Limits (UCL) of the I-MR are computed with the formula

$$\text{Individual control limits} = \bar{x} \pm \frac{3R}{d_2} \quad (1)$$

$$\text{Moving Range control limits} \quad (2)$$

$$\text{LCL} = 0$$

$$\text{UCL} = D_4 M\bar{R},$$

Where d_2 , and D_4 are constants and predefined for each sample size. The research fitted the forecasting model with

$$y_i = \beta_0 + \beta_1 x_i + e, \quad (3)$$

where x and y are the days (independent) and blood sugar levels (dependent) variables respectively and e is the error term (Murairwa, 2019; 2016). The model can be used to predict blood sugar levels. The research applied the Runs test at a 5% level of significance to determine the randomness of the blood sugar level data with the formula

$$Z = \frac{R - \mu_R}{\sqrt{\sigma_R^2}}, \quad (4)$$

Where $\text{var}(R) = \sigma_R^2 = \frac{2n_1 n_2 (2n_1 n_2 - n_1 - n_2)}{(n_1 + n_2)^2 (n_1 + n_2 - 1)}$, R = number of runs, $\mu_R = E(R) = \frac{2n_1 n_2}{n_1 + n_2} + 1$, n_1 = number of + symbols, n_2 = number of - symbols, and $n_1 > n_2$.

The hypothesis used is H_0 : The pattern of occurrence of the blood sugar data is random versus H_1 : The pattern of occurrence of the blood sugar data is not random. The research applied a one-sample t-test to determine whether the strategies used were effective in managing Type 2 diabetes with the hypothesis $H_0: \mu = 6.1 \text{ mmol/L}$ vs $H_1: \mu \neq 6.1 \text{ mmol/L}$. The strategies employed by the researcher include a healthy diet, taking medication, reducing body weight, and performing light physical activities and exercises.

The sample t-test (Murairwa, 2019; 2016) was computed with

$$Z = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}}, \tag{5}$$

Where \bar{x} is the sample mean, μ is the hypothesised population mean, s is the sample standard deviation and n is the size of the research sample.

RESULTS AND DISCUSSION

The researcher fitted a scatter plot for 45 blood sugar level data points and presented the graph in Figure 2.



Figure 2: Blood Sugar Levels Scatter Plot (23/10/20 – 20/05/2022).

Figure 2 shows that all the blood sugar level data points are between the acceptable 5.0 mmol/L and 7.2 mmol/L except for the 4.60 mmol/L data point that was recorded on 14 October 2021 which is below 5.0 mmol/L. As expected, there is no relationship between the blood sugar levels and the date the blood sugar level data was measured. The blood sugar level varies with time but not with date. The statistics of the blood sugar level data collected for the study are presented in Table 3.

Table 3: Blood Sugar Level Descriptive Statistics (23/10/20 – 20/05/2022).

		<i>mmol/L</i>
N	Valid	45
	Missing	0
Mean		5.964
Std. Error of Mean		0.0795
Median		6.000
Mode		5.8
Std. Deviation		0.5335
Variance		0.285
Skewness		-0.270
Std. Error of Skewness		0.354
Kurtosis		-0.142
Std. Error of Kurtosis		0.695
Range		2.4
Minimum		4.6
Maximum		7.0
Sum		268.4
Percentiles	25	5.60
	50	6.0
	75	6.35

Table 3 shows that 75% of the blood sugar level data points were below 6.35 mmol/L and that indicates that the blood sugar level was normal from 23 October 2020 to 20 May 2022. This is supported by the mean of 5.964 mmol/L which falls between the acceptable lower and upper limits of 5.0 mmol/L and 7.2 mmol/L respectively for adult people before eating food. A 95% confidence interval of the blood sugar level data is **5.804 mmol/L ≤ μ ≤ 6.125 mmol/L**. The confidence interval contains a mean of 5.964 mmol/L. Thus, the mean is within the acceptable lower limit of 5.0 mmol/L and the upper limit of 7.2 mmol/L. The centre limit of the acceptable interval is 6.1 mmol/L. The difference between the centre limit (CL) of 6.1 mmol/L and the mean of 5.964 mmol/L of the gathered blood sugar level data is insignificant and therefore, they are statistically the same. The variance of the blood sugar level data is 0.285 mmol/L. The value indicates how closely dispersed are the blood sugar level data points around the mean of 5.964 mmol/L. This is supported by a standard error of the mean of 0.0795 mmol/L and a coefficient of variation of 0.0895 mmol/L. The variation in the researcher’s blood sugar levels from 23 October 2020 to 20 May 2022 is presented in Figure 3.

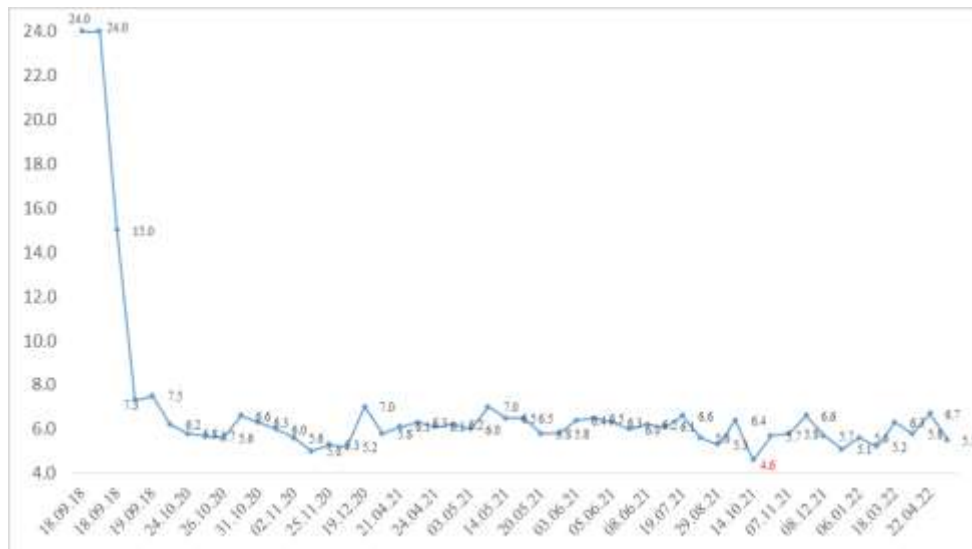


Figure 3: Researcher's Blood Sugar Level Variation.

Figure 3 presents the 50 blood sugar data points including the 5 data points recorded during the diabetes diagnosis. Figure 3 presents four phases, namely, the diabetes diagnosis (DD) phase which lasted for half an hour from 6 pm on 18 September 2018, the medication control (MC) phase which lasted for more than two years from 18 September 2018 to 22 October 2020, diet control (DC) phase which lasted for more than one and half years from 23 October 2020 to 20 May 2022 and complete remission (CR) phase which spanned from 21 May 2022 to July 2023. The control measures used during the MC phase involved taking the prescribed diet, taking diabetes medication at predetermined intervals, and monitoring, measuring, analysing, and reporting the results to the diabetologist (DB). The complete remission (CR) is supported by the findings in FA (2023) that nearly half of Food Addicts in Recovery Anonymous (FA) members who joined with Type 2 diabetes reported complete remission.

Figure 3 shows an out-of-control recording of 4.6mmol/L on 14 October 2021. This was due to a delay in testing the blood sugar level. The researcher was measuring blood sugar levels at 8 am every time but on that particular day, he forgot to measure until 10 am before taking meals. The out-of-control point shows that the researcher's blood sugar was normal. This is so because a normal fasting blood sugar level should be less than 5.6mmol/L (Dansinger, 2023b). On 12 May 2021, the researcher ate sweet potatoes before going to bed and the recording on 13 May 2021 was 7.0mmol/L. Sweet potatoes can improve insulin sensitivity but may also cause blood sugar issues in persons with diabetes (Wellcurve, 2022). This agrees with Zee Media Bureau (2022) which stated that hyperglycemia is caused by overconsumption of sugar, processed food, and carbs. Sometimes the researcher would eat more sadza and fruits than prescribed by the dieticians. However, the pattern of the curve in Figure 3 presents a stable pattern because all the blood sugar level data points were

between 5.0mmol/L and 7.2mmol/L which according to Sandeep and Dhaliwal (2022) is the normal blood sugar range for adult people before eating food. The qualitative data collected from the pharmacist, general practitioners (GP1, GP2, and GP3), diabetologists (DB1, DB2, and DB3), and dieticians (D1, D2, and D3) are henceforth presented and discussed. The researcher visited the Health Gate pharmacy in Mutare for diabetes testing. After the diabetes test, the pharmacist said

"You are diabetic. Your blood sugar level is 24.0mmol/L. You cannot go home in this condition. You must consult a general practitioner 1 (GP1) at Second Street Medical Clinic."

The results imply that the researcher's blood sugar level was out of control as stated by Sandeep and Dhaliwal (2022). The blood sugar level was supposed to be less than 10 mmol/L one to two hours after taking meals to be normal. The researcher consulted the general practitioner 1 (GP1). After the diabetes test, the GP1 said.

"Your blood sugar level is too high. It is 24 mmol/L. You are diabetic. How long have you been diabetic? I am booking you in for overnight monitoring of your hyperglycemia. Your body weight is 98 kilograms; it is too high. You need to reduce your body weight to around 70 kilograms."

The results confirm the pharmacist's findings. The researcher wanted to drive 265 kilometres to his family doctor in Harare instead of spending a night at Mutare Second Street Medical Clinic. The GP1 said.

"I will not allow you to drive in this health condition. I will inject you with 10 millilitres of insulin and test your blood sugar level after 30 minutes. If your blood sugar level decreases to an acceptable level, I will allow you to drive to your family doctor in Harare; otherwise, you will spend a night here."

The researcher agreed and after 30 minutes the blood sugar level decreased to 15 mmol/L as shown in Figure 3 in the DD phase. The GP1 could have used either Rapid-Acting or Regular Short-Acting insulin to get the results after 30 minutes according to WebMD (2022). The GP1 was satisfied despite that it was still more than 10 mmol/L according to Sandeep and Dhaliwal (2022). The results indicate the need for persons with diabetes to respect the recommendations of physicians. The researcher was instructed to test the blood sugar level at a general practitioner 2 (GP2) clinic in Ruwa on the same day. Dietician 1 (D1) advised the researcher to control diabetes with a healthy diet and light physical activities and exercises. After the diabetes test, the GP2 said.

“Your blood sugar level is normal. It is 7.3mmol/L. However, you must consult a diabetologist for a glucose tolerance test to determine what could have triggered your blood sugar level to rise to 24mmol/L. Despite this, you can start controlling your blood sugar level with a healthy diet.”

The results prompted the researcher to consult another general practitioner 3 (GP3) on the issue because of several unanswered questions. Was the blood sugar level normal? What could have triggered the blood sugar level to rise? These questions required answers. After the diabetes test, the GP3 said.

“It is normal. It is 7.5 mmol/L. You should monitor and control your blood sugar levels with a healthy diet. After this session, the dietician will give you a list of the food you should eat starting today. Madam, referring to my wife, don't give your husband too much Sadza. Please follow religiously the recommendations of the dietician. You should consult a physician (DB1) for the answers to your questions.”

Dietician 2 (D2) explained the healthy diet and handed over a list of food that the researcher was supposed to eat at tea, lunch, and dinner times. The results reveal the need for laboratory testing of the researcher's blood samples to determine what could have caused the hyperglycemia. After reading the glucose tolerance test results from the laboratories, the DB1 said.

“You experienced random diabetes attacks. Madam, your husband is diabetic. You have been diabetic for more than twelve years. This is not the end of the world. I am giving you medication and a healthy diet to control diabetes. You should reduce your body weight from 98 kilograms to around 70 kilograms. I am referring you to an eye specialist for the eye test for diabetic retinopathy, macular edema, cataracts, and glaucoma.”

The results appear to be contradicting one of the diabetes symptoms by Mayo Clinic Staff (2021) that a diabetic person loses body weight. However, the National Institute of Diabetes and Digestive and Kidney

Diseases (NIDDK) (2023) stated that 90% of persons with Type 2 diabetes are overweight or obese. The researcher inquired whether a healthy diet could be adopted as the initial option to control diabetes attacks instead of medication or both. The inquiry angered the DB1 who said.

“Why are you here if you do not have confidence in me? I am also diabetic and have been taking medication for more than 20 years now. Look at my master's certificate on the wall. I am a diabetes specialist. I am recommending Galvus Met (50 mg/1000 mg) and Rosuvastatin Tablets (10 mg). Dietician 3 (D3) will give you lessons on a healthy diet. Please implement the diet as recommended.”

The researcher obeyed but wondered what could have triggered the DB1's anger that led to the outburst. The outburst confused the researcher and raised several questions. Are diabetologists not supposed to be asked questions during consultations? What is a consultation? Am I consulting the right diabetologist? The questions created the need to consult a second diabetologist 2 (DB2). On the healthy diet, the D3 said.

“You should eat sadza three times per day at tea, lunch, and dinner times. The quantity of sadza should be two portions of the size of your fist with a drumstick of chicken and a lot of vegetables. In place of chicken, you can eat two pieces of beef of a matchbox size each. You must eat snacks every two hours after the main meal to avoid getting hungry. You should not drink tea even without sugar but drink a lot of water. Do not drink any sugar flavoured drinks. You should eat butternuts, or pumpkins more often in place of sadza, rice, or potatoes. Do not eat fried meat. You should reduce cooking oil when preparing vegetables, and stew. You should eat an egg per week when necessary. You must do light physical activities and exercises daily. You must reduce and maintain a body weight of around 70 kilograms.”

The results indicate that persons with diabetes must avoid taking sugar-flavoured food and drinks. A person with diabetes should do light physical activities and exercises, reduce cooking oil when preparing food, eat a lot of vegetables, and maintain a body weight of around 70 kilograms. The question of controlling Type 2 diabetes with a healthy diet remained unanswered. After six months of taking diabetes medication, the researcher decided to consult a second diabetologist 2 (DB2). After reading the glucose tolerance test results from the laboratories, the DB2 said.

“You experienced random diabetes attacks. However, I have never seen in my life the Galvus Met (50 mg/1000 mg) and Rosuvastatin Tablets (10 mg) being prescribed for new persons with Type 2 diabetes. Persons with Type 2 diabetes are prescribed metformin with a healthy diet and light physical activities and exercises. I will change the Galvus Met (50 mg/1000 mg) and Rosuvastatin

Tablets (10 mg) that you are currently taking to metformin. So far, I have not recommended a person with Type 2 diabetes to stop taking diabetes medication in preference for a healthy diet. So, you will continue on diabetes medication, a healthy diet, and light physical activities and exercises."

The results confirm that the researcher had experienced random Type 2 diabetes attacks for more than twelve years. The results imply that diabetologists sometimes do experiments without the consent of the patients. What was interesting was the DB2's surprise at the medication that was prescribed by DB1 for a new person with Type 2 diabetes. It was, therefore, advisable to seek the opinion of diabetologist 3 (DB3) for confirmation. Sadly, DB2 passed on in 2019. The results reveal different approaches to controlling Type 2 diabetes. The diet was reviewed to increase the quantity of food taken by the researcher. Dietician 4 (D4) said.

"You will continue with the light physical activities and exercises that were recommended by Dietician 3 (D3). However, I am reviewing the healthy diet. You can now drink tea with sweetener, or honey and 2% low-fat milk at tea time. You now eat sadza at lunch and dinner times. You continue eating snacks between main meals. You do not need to starve yourself. You should eat enough sadza, mashed potatoes, or rice since you are on diabetes medication."

The results confirm different approaches to managing Type 2 diabetes. The D3 believes in reducing body weight to around 70 kilograms, taking diabetes medication, and doing light physical activities and exercises. Dietician 4 (D4) believes in the constant taking of diabetes medication without maintaining the body weight to around 70 kilograms. The slight variation in approaches to control Type 2 diabetes created more questions than answers. Which approach is appropriate for the researcher? How can Type 2 diabetes be controlled? Which approach can manage Type 2 diabetes better? Can Type 2 diabetes be managed by a healthy diet and light physical activities and exercises? The patient consulted Diabetologist 3 (DB3) to get answers to some of the questions. After reading the glucose tolerance test results from the laboratories, the DB3 said.

"Your blood sugar level is normal. However, I do not advise patients to stop taking diabetes medication. The glucose tolerance test results from medical laboratories do that. I will take your blood samples and send them to medical laboratories for testing. I will recommend several tests. If all the test results are acceptable, you will stop taking diabetes medication. I have done tests of several adult persons with diabetes whose blood sample results were acceptable and they stopped taking the medications without experiencing future complications."

The researcher's blood samples were taken for medical laboratory testing. The researcher continued taking medication, a healthy diet, and light physical activities and exercises as recommended by Dietician 4 (D4). After reading the glucose tolerance test results from laboratories, the DB3 said.

"Your blood sugar level is normal. I traced the random diabetes attack up to the period you started taking diabetes medication. The results from the medical laboratories show that all the body organs are functioning well. I don't have any reason to keep you on diabetes medication. You should immediately stop taking diabetes medication and take meals as usual. You should drink tea with sugar. I want to investigate the source of the Type 2 diabetes random attack that you experienced. Take my contact mobile number for any emergency anywhere at any time, just call me."

The results of the glucose relevance test from the medical laboratories confirm complete remission from Type 2 diabetes. The results confirm the findings by FA (2023) that nearly 50% of the participants who joined with Type 2 diabetes had complete remission. Several unproven remedial traditional strategies were considered during the researcher's Type 2 diabetes experience. A work colleague suggested boiling the head of a pineapple and drinking the water as tea. This is believed to normalise the blood sugar level of a person with diabetes. The other colleague suggested boiling mulberry leaves and drinking a little of the boiled water when the blood sugar level is extremely high. The water from the boiled mulberry leaves is believed to lower hyperglycemia proportionally to the amount of water drunk. So the water from boiled mulberry leaves can only be used when the person has hyperglycemia and not hypoglycemia. The other colleague advised me to eat Okra to control Type 2 diabetes. Okra acts as natural insulin that lowers the blood sugar levels (Kofi004, 2021). Therefore, care should be taken because traditional therapies can reduce the blood sugar levels to dangerous low levels (DCU, 2023). The researcher drank water from the boiled head of pineapple and ate okra at a predetermined interval of three months and every week respectively because of the flexibility of the traditional remedies. However, these traditional remedies require medical (clinical) laboratory approval for persons with diabetes to use them. The researcher constructed the Individual and Moving Range Control charts for the blood sugar level data.

Individual and Moving Range Control charts

The research fitted the Individual and Moving Average (I-MR) control charts to the blood sugar level data and presented the results in Figures 4 and 5. The Individual Control chart of the blood sugar level data is presented in Figure 4.

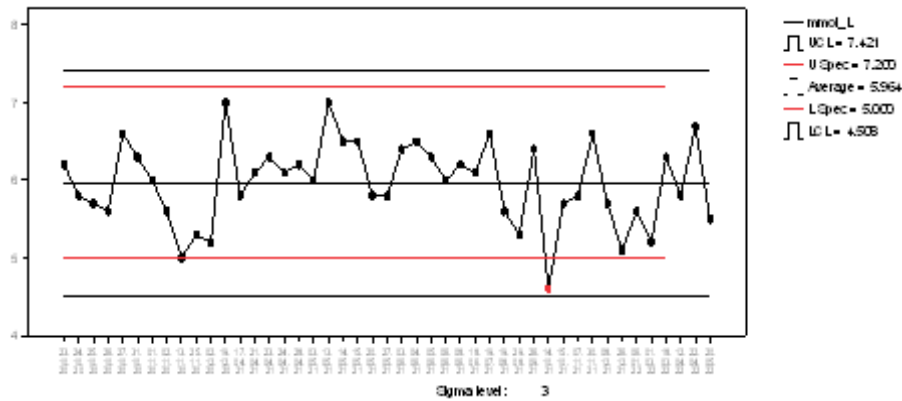


Figure 4: Blood Sugar Individual Control Chart.

Figure 4 shows that all the blood sugar data points fall within the Lower Specification Limit (LSL) of 5.0 mmol/L and Upper Specification Limit (USL) of 7.2 mmol/L except for the data point that was recorded on 14 October 2021. The blood sugar level measurement was conducted at 10 am instead of 8 am before meals. However, the blood sugar level of 4.6mmol/L is below the normal fasting sugar level of 5.6 mmol/L as stated by

Dansinger (2023b). Thus, it was normal. Therefore, the individual control chart successfully detected that blood sugar level is affected by time. The blood sugar level statistics indicate that 2.22% of the blood sugar data points fall outside the accepted Lower Control Limit (LCL) of 5.0 mmol/L and Upper Control Limit (UCL) of 7.2mmol/L. The moving range control chart of the blood sugar level data is presented in Figure 5.

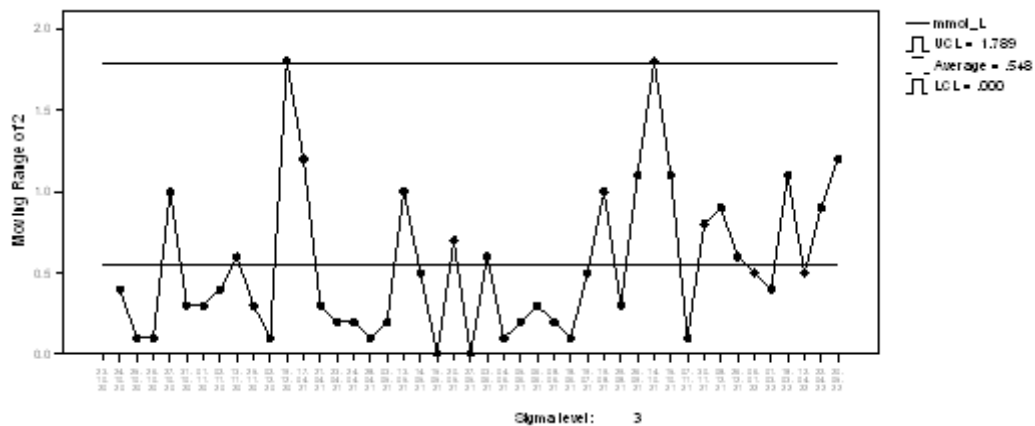


Figure 5: Moving Range of 2 Control Chart.

Figure 5 shows the tracking of the absolute difference between adjacent blood sugar data points. The variations in the blood sugar levels were stable and predictable. All the data points are within the lower control limit (LCL) of 0.000 mmol/L and the upper control limit (UCL) of 1.789 mmol/L. Therefore, the blood sugar levels were

within the acceptable lower and upper specification limits of the Moving Range of 2 Control chart. The researcher’s blood sugar levels were normal during the study period. The research fitted the regression equation and presented the results in Table 4.

Table 4: Model Coefficients(a).

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
mmol/L	Constant	6.054	0.163		37.174	0.000
	Day (d)	-0.004	0.006	-0.096	-0.632	0.530

Dependent Variable: mmol/L

Table 4 shows the coefficients of the blood sugar level (BSL) model. The regression model is $BSL = 6.054 - 0.004d$. Since the gradient of the model is approximately equal to zero, the weak negative

association ($r = -0.096$) between blood sugar level and day of blood level test is insignificant. This is supported by a p-value of 0.530 mmol/L which is greater than 5% level of significance. Therefore, there is no relationship between the blood sugar level and the day

the blood sugar level test was done. However, the insignificant weak inverse relationship implies that from waking up until the first meal, the blood sugar level will be decreasing slowly but should be less than 5.6 mmol/L to be normal under fasting blood sugar level as stated by Dansinger (2023b). That is why it is urged not to miss a

meal and to eat snacks or fruits every two hours between the main meals for persons with Type 2 diabetes. The research applied the Runs test to determine the randomness of the blood sugar level data. The Runs test results for the mean, median, model constant (MC), and centre line (CL) statistics are presented in Table 5.

Table 5: Runs Test Results.

Test Value	Mean	Median	MC	CL
	5.964	6.0	6.054	6.100
Cases < Test Value	21	21	-	-
Cases >= Test Value	24	24	-	-
Total Cases	45	45	45	45
Number of Runs	18	18	22	22
Z	-1.485	-1.485	-0.273	-0.273
Asymp. Sig. (2-tailed)	0.138	0.138	0.785	0.785

The results for the mean and median test values are the same. The statistics are

$n_1 = 21, n_2 = 24, runs = 18$ and $p - value = 0.138$.

At a 5% level of significance, the p-value is greater than the level of significance, therefore the order of the blood sugar level data is random. The difference between $n_1 = 21$ and $n_2 = 24$ is statistically insignificant. Therefore, approximately 50% of the blood sugar level data points lie above and below the Runs test values. This means that the Runs test results for the mean and median test values are statistically the same. The Runs test results support the null hypothesis that the blood sugar level data is random. The research tested whether

the model constant (MC) of 6.054 mmol/L and the centre line (CL) of 6.1 mmol/L could detect randomness of the blood sugar levels and presented the Runs test results in Table 5. For both the MC and CL, the $p - value = 0.785 > \alpha = 0.05$ for the blood sugar level data. There is no evidence to reject the null hypothesis that the blood sugar level data is random. A sample *t-test* was applied to test whether the strategies employed by the researcher were effective in managing the blood sugar level to normal ($\mu = 6.1 \text{ mmol/L}$). The computed one-sample t-test results are presented in Table 6.

Table 6: One-Sample t-Test Results.

Test Value = 6.1 mmol/L					
t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
				Lower	Upper
-1.704	44	0.095	-0.1356	-0.296	0.025

Table 6 shows a p-value of 0.095 which is greater than 0.05 level of significance; $p - value = 9.5\% > \alpha = 5\%$. Therefore, there is no evidence to reject the null hypothesis that the strategies employed were effective in managing the blood sugar level to normal. Thus, the employed strategies (such as diabetes medication and a healthy diet) are important for managing Type 2 diabetes to normal. A healthy diet should include fruits, vegetables, proteins, carbohydrates, and healthy fat in the required amounts by the body. However, there is no specific diet for persons with diabetes because Palinski-Wade (2015) stated that there is no forbidden food. The research proposed a framework for managing Type 2 diabetes.

A Framework for Managing Type 2 Diabetes

The research proposed a framework for managing Type 2 diabetes. Figure 6 presents the framework that was adopted by the researcher when he was diagnosed with Type 2 diabetes on 18 August 2018. There are six activities that a person with diabetes must implement to

effectively manage Type 2 diabetes as shown in Figure 6.

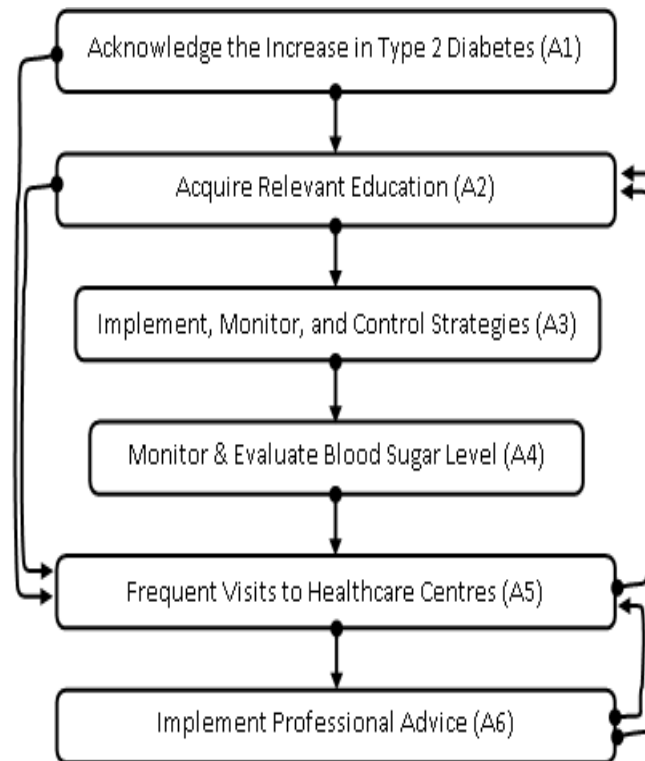


Figure 6: Framework for Managing Type 2 Diabetes.

The activities (As) of the framework for managing Type 2 diabetes that is presented in Figure 6 are explained henceforth.

A1: Acknowledge the increase in Type 2 Diabetes. An individual should accept that Type 2 diabetes is on the increase and could be affected by the ailment. The individuals should constantly check for symptoms and visit healthcare centres for check-ups. The best way to reduce its prevalence is through prevention at the normal and prediabetes phases.

A2: Acquire relevant education on Type 2 diabetes. A person with diabetes should strive to get education on the causes, symptoms, measurements, and effects of Type 2 diabetes. This research presents some of the literature information that can be read to understand Type 2 diabetes. The person with Type 2 diabetes should on selected days test the blood sugar levels and compare with the benchmarks that are presented in Table 7.

Table 7: Adult Blood Sugar Levels.

Measurement Time/Condition		mmol/L
Morning	Before Eating Meals	5.0 – 7.2
1 - 2 hours	After Eating Meals	< 10
Evening	At Bedtime	5.0 – 8.3
Fasting	Normal	< 5.6
	Impaired	5.6 – 7.0
	Diabetes	> 7.0

Table 7 shows the blood sugar levels that people can use to monitor and control their Type 2 diabetes. The reference table is important to adult people who test their blood sugar levels at home. The adult person with diabetes also needs to know the historical diabetes experiences of his/her family members and how it was managed.

formulate, implement, monitor, and control strategies that manage Type 2 diabetes such as a meal plan. A meal plan should be put in place to reduce getting hungry, eat food and constant intervals, and eat acceptable quantities of food. This will reduce the chance of developing Type 2 diabetes. It is advisable to do activities and exercises that are guided by the specialist as part of monitoring and controlling Type 2 diabetes. A meal plan (healthy diet) is presented in Table 8.

A3: Implement, Monitor, and Control Strategies. Whether one has Type 2 diabetes or not, it is advisable to

Table 8: A Healthy Diet for Persons with Type 2 Diabetes.

Meal	Time	Portion
Tea	10 am	<ul style="list-style-type: none"> • Two slices of brown bread • Beans, boiled egg, or peanut butter • Green tea without sugar • Powdered or liquid milk (2% fat)
Lunch	1 pm	<ul style="list-style-type: none"> • Sadza (two fist sizes), rice (two standard tea cups), Pumpkins, or mashed potatoes (two fist sizes) • A drumstick, beef (two matchbox sizes, or palm size), or fish (palm size) • A lot of vegetables
Dinner	6 pm	<ul style="list-style-type: none"> • Sadza (two fist sizes), rice (two standard tea cups), Pumpkins, or mashed potatoes (two fist sizes) • A drumstick, beef (two matchbox sizes, or palm size), or fish (palm size) • A lot of vegetables
Inter-Meal Snacks	After 2 hours	<ul style="list-style-type: none"> • A fruit (medium size), or popcorn (two standard tea cups), or groundnuts (cupped hand)
Every week	Anytime	<ul style="list-style-type: none"> • Eat Okra
	10 am	<ul style="list-style-type: none"> • Drink Pineapple head tea (normal teacup size)
	10 am	<ul style="list-style-type: none"> • Drink guava tea

It is important for a person with diabetes not to miss meals and inter-meal snacks as presented in Table 8. A person with diabetes should neither get hungry nor eat too much food per meal. This raises a question on the amount of Sadza that a person should eat per meal. The appropriate question is “*Do we still need Sadza in our healthy diet?*” This is because Sadza is low in nutrients such as vitamins, minerals, and proteins and too much of it leads to obesity. However, a well-planned and implemented healthy diet and light physical, activities and exercises should control the body weight of a person with diabetes to around 70 kilograms. The persons with Type 2 diabetes are also advised to include traditional remedies in their meal plan as presented in Table 8.

A4: Monitor and evaluate blood sugar levels. This involves observing, measuring, comparing, and interpreting the results. The two major activities are glucose tolerance testing and food journaling. Persons with Type 2 diabetes should purchase a blood sugar testing machine and frequently test, record, analyse, and interpret the results. The recorded blood sugar level data and results should be given to the diabetologist for in-depth statistical analysis and interpretation.

A5: Frequent visits to the healthcare centres. This is necessary for glucose tolerance tests. For persons with Type 2 diabetes, frequent visits to healthcare centres will be for diabetes education and testing. The visits can also be opportunities to submit recorded blood sugar level data and get the interpretation of the results.

A6: Implement religiously the advice by the diabetologist and dietician on medication, a healthy diet, and light physical activities and exercises. A person must implement all the recommendations by the diabetologist and dietician for successful monitoring and controlling of Type 2 diabetes.

CONCLUSION AND RECOMMENDATIONS

A person with Type 2 diabetes can with the support of a diabetologist and dietician monitor and control the ailment to complete remission. The person with diabetes should implement the prescription and meal plan recommended by the diabetologist and dietician respectively. In literature, the diabetes prevalence rate in Zimbabwe is 10%; thus, 10 in every 100 people are diabetic. This is a high rate given the fatality of the ailment. The research pointed out the importance of education on the symptoms, effects, and control of Type 2 diabetes in adult persons. There is adequate information in the literature on Type 2 diabetes for people to learn from. The research established three activities that are critical for persons with diabetes to implement and these are a healthy diet, diabetes medication, and light physical activities and exercises. The research demonstrated that the strategies that were adopted and implemented by the researcher to manage Type 2 diabetes were effective. One unique strategy that was adopted was the traditional method to manage Type 2 diabetes. However, there is a need to collect data on all the strategies adopted and measure the contribution of each to maintaining the blood sugar level to normal if not to complete remission. The research proposed a framework for managing Type 2 diabetes in adult persons. The framework outlines the diabetes management process, meal plan, and light activities and exercises that should be implemented by adult persons with Type 2 diabetes. The framework to manage Type 2 diabetes was developed from the researcher’s own experience with the ailment. There is no known cure for diabetes but persons with diabetes should take medication, lose weight, get self-management education, maintain a healthy diet, frequently visit healthcare centres, do light physical activities and exercises, and take traditional therapies to reduce the effects of the ailment.

Declaration of Conflicting Interests

The author declares no potential conflicts of interest concerning the research, authorship, and publication of this article.

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REFERENCES

- American Diabetes Association. Standards of medical care in diabetes. *Diabetes Care*, 2011; 34(1): S11–61. doi: <https://doi.org/10.2337/dc11-S011>.
- CDC. (2022, December 30). *Gestational Diabetes*. Retrieved from Centers for Disease Control and Prevention: <https://www.cdc.gov/diabetes/basics/gestational.html#:~:text=What%20Causes%20Gestational%20Diabetes%3F,body%20for%20use%20as%20energy>.
- CDC. (2023, February 28). *Centre for Disease Control and Prevention*. Retrieved from Diabetes Tests: <https://www.cdc.gov/diabetes/basics/getting-tested.html>
- Dansinger, M. (2023, March 16). *Type 2 Diabetes*. Retrieved from WebMD: <https://www.webmd.com/diabetes/type-2-diabetes>
- Dansinger, M. (2023b, March 18). *WebMD*. Retrieved from Glossary of Diabetes Terms: <https://www.webmd.com/diabetes/diabetes-glossary-terms#:~:text=Normal%20fasting%20blood%20glucose%20is,but%20may%20not%20have%20diabetes>.
- DCU. (2023, January 25). *Herbal and Natural Therapies*. Retrieved from Diabetes.co.uk: <https://www.diabetes.co.uk/Diabetes-herbal.html>
- FA. (2023). *FA and Diabetes*. Retrieved from Food Addicts in Recovery Anonymous: https://www.foodaddicts.org/fa-and-diabetes?gad=1&gclid=CjwKCAjw6vyiBhB_EiwAQJRopl2NEWl4j8rVEwwtOUwU4cucKLLzVpkmE187lkuSICXJw2VO9Fuk5xoCefwQAvD_BwE
- Kofi004. (2021). *If You Are Suffering From Any Of These nine Dangerous Diseases, Just Eat Okro*. Retrieved from Opera News: <https://gh.opera.news/gh/en/health/59bd7f0fac81a5d4be4e95b5fe1e7acf7>
- Mayo Clinic Staff. (2021, June 3). *Diabetes symptoms: When diabetes symptoms are a concern*. Retrieved from Mayo Clinic: <https://www.mayoclinic.org/diseases-conditions/diabetes/in-depth/diabetes-symptoms/art-20044248#:~:text=Excessive%20thirst%20and%20increased%20urination%20are%20common%20diabetes%20signs%20and,and%20absorb%20the%20excess%20glucose>.
- Mayo Clinic staff. (2022, August 19). *Diabetes*. Retrieved from Mayo Clinic: <https://www.mayoclinic.org/diseases-conditions/diabetes/diagnosis-treatment/drc-20371451#:~:text=A%20fasting%20blood%20sugar%20level,separate%20tests%2C%20you%20have%20diabetes>.
- MHCC. (2020). *Diabetic Association on a nationwide drive*. Retrieved November 6, 2022, from Ministry of Health and Child Care (MHCC): http://www.mohcc.gov.zw/index.php?option=com_content&view=article&id=196:diabetic-association-on-a-nationwide-drive&catid=84&Itemid=435#:~:text=%E2%80%9CIn%20Zimbabwe%2C%20it%20is%20estimated,at%20outpatients%20departments%20per%20year.%E2%80%9D
- Murairwa, S. Voluntary Sampling Design. *International Journal of Advanced Research in Management and Social Sciences*, 2015; 4(2): 185-200. Retrieved from <http://www.garph.co.uk/IJARMSS/Feb2015/18.pdf>
- Murairwa, S. (2016). *Murairwa, S. (2016). RESEARCH AND STATISTICS with application procedures in statistical package for social sciences*. India: Research Foundation, Publishers and Subscription Agents of International and Indian Journals.
- Murairwa, S. (2019). *RESEARCH AND STATISTICS with application procedures in statistical package for social sciences* (First Edition ed.). Zimbabwe: Media Essentials.
- Mutowo, M., Gowda, U., Mangwiro, J. C., Lorgelly, P., Owen, A., & Renzaho, A. Prevalence of diabetes in Zimbabwe: a systematic review with meta-analysis. *International Journal of Public Health*, 2015; 1 - 11. doi:10.1007/s00038-014-0626-y
- NDDK. (2023, March). *National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK)*. Retrieved from Health Risks of Overweight & Obesity: <https://www.niddk.nih.gov/health-information/weight-management/adult-overweight-obesity/health-risks#:~:text=Nearly%209%20in%2010%20people,diabetes%20have%20overweight%20or%20obesity.&text=Over%20time%2C%20high%20blood%20glucose,damage%2C%20and%20other%20>
- Palinski-Wade, M. D. (2015). *2-Day Diabetes Diet: Diet Just 2 Days a Week and Dodge Type 2 Diabetes*. Trusted Media Brands.
- Punthakee, Z., Goldenberg, R., & Katz, P. Definition, Classification and Diagnosis of Diabetes, Prediabetes and Metabolic Syndrome. *Canadian Journal of Diabetes*, 2018; 42: S10 – S15.
- Sandeep, K., & Dhaliwal, M. D. (2022, January 2). *Managing your blood sugar*. Retrieved September 10, 2022, from MedlinePlus: <https://medlineplus.gov/ency/patientinstructions/00086.htm>

20. Sneha, N., & Gangil, T. (2019). Analysis of diabetes mellitus for early prediction using optimal features selection. *Journal of Big Data*, 13(6). doi:<https://doi.org/10.1186/s40537-019-0175-6>
21. Sun, H., Saeedi, P., Karuranga, S., Pinkepank, M., Ogurtsova, K., Duncan, B., . . . et al. (2021). IDF Diabetes Atlas: Global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diabetes Research and Clinical Practice*. doi:10.1016/j.diabres.2021.109119
22. The diaTribe Foundation. (2023). *Diabetes Terminology*. Retrieved from diaTribe Learn: Making Sense of Diabetes: <https://diatribe.org/diabetes-terminology>
23. Washington, G. (2023). *Diabetes Rates by Country*. Retrieved from Wisevoter: <https://wisevoter.com/country-rankings/diabetes-rates-by-country/>
24. WebMD. (2022, August 25). *Types of Insulin for Diabetes Treatment*. Retrieved from WebMD: <https://www.webmd.com/diabetes/diabetes-types-insulin>
25. Wellcurve. (2022). *Wellcurve.in*. Retrieved November 6, 2022, from Sweet Potato Benefits, Nutrition Value & Side Effects: <https://www.wellcurve.in/blog/sweet-potato-benefits-and-nutrition-facts/>
26. Zee Media Bureau. (2022, November 4). High blood sugar causes: 7 surprising, daily things that can increase your insulin levels. *ZeeNews*. Retrieved November 5, 2022, from <https://zeenews.india.com/health/high-blood-sugar-causes-7-surprising-daily-things-that-can-increase-your-insulin-levels-2527521>