The Assessment and Connection of the PRHC Diabetes Health Care Clinic with Community Partners

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Diabetes Care: An Evaluation of Best Practices in Collaboration with Peterborough Regional Health Centre and Community Partners

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Abstract

The goal of this paper is the evaluate the best practices used for diabetes across the country and create a set of recommendations that the Peterborough Regional Health Center's Diabetes Clinic can use to improve their level of care. The clinic is currently suffering from too many patients and not enough funding- creating a deficit in the care they are able to give. Diabetes mellitus, a chronic condition, is brought on by insufficient insulin production by the pancreas. Diabetes may be divided into four groups: type 1, type 2, gestational diabetes, and diabetes brought on by other illnesses. Diabetes may be managed using a variety of techniques and medications.

This paper explores diabetes diagnosis, treatment and education. It then looks at current Diabetes best practices from around the country and world. This information is used in collaboration with information taken from the clinic staff to create a number of recommendations. These recommendations include using telehealth services and virtual visits to improve patient access while reducing staff work. It is also necessary to reinstate group consultations in order to manage minor medical difficulties.Working together with the recently established Community Health Centre may also help to reduce the workload at the clinic by offering group education sessions and early diagnosis and treatment to patients who are not as important. It's crucial to understand, though, that these recommendations rely on having enough personnel and funding. By implementing these strategies, the PRHC Diabetes Clinic will be able to maintain its reputation for excellence in diabetes treatment within the community, enhance patient care, and lessen operational challenges.

Introduction to Diabetes and Diabetes Care

Introduction

Diabetes mellitus is a chronic disease that can occur for two reasons. Firstly, when the pancreas is not able to produce enough insulin. Secondly, when the body cannot efficiently use the insulin that is produced (WHO, 2023). Blood glucose is regulated by a hormone called insulin; this hormone is used in the body to control glycemic levels. Diabetes is broken down into four categories: type 1, type 2, gestational and diabetes caused by other conditions. Diabetes can be treated by several different methods and drugs. Depending on the level of disease progression at the time of diagnosis lifestyle changes might be the only thing to start treatment with or it might be prescribed in conjunction with drugs. As science progresses so do the recommended treatment methods and drugs used to treat it. Newer drugs are on the market faster than most healthcare professionals can keep up.

Diabetes is distinguished by hyperglycemia which is elevated blood glucose levels for some time (Banday et al., 2020). Hyperglycemia comes about from abnormal insulin action or secretion or both- it shows its symptoms in a chronic way as fat, carbohydrate and protein metabolic dysfunctions (Banday et al., 2020). These dysfunctions then affect many other organs in the body and alter their normal functioning. As mentioned before there are 4 different types of diabetes, each being caused in their pathophysiological ways. Type 1 diabetes is an autoimmune disorder caused by T-cell mediated destruction of the body's pancreatic beta-cells. This leads to insulin deficiency and as a result, hyperglycemia (Banday et al., 2020). This type of diabetes is influenced by environmental and genetic factors.

Diabetes typically occurs as a result of excess caloric intake and inadequate insulin secretion. (Andreas F. H Pfeiffer et al., 2014). The caloric excess creates an inhibition of the

uptake of the energy-bearing substrate into the liver, muscle and adipose tissue which creates the clinical presentation of insulin resistance (Andreas F. H Pfeiffer et al., 2014). This insulin resistance causes hyperglycemia if the beta-cells cannot compensate. This beta-cell response is determined through genetic and epigenetic means (Andreas F. H Pfeiffer et al., 2014).

Type 2 Diabetes: Mechanism

Type 2 diabetes is characterized by two abnormalities that are insulin-related- beta-cell dysfunction and insulin resistance (Banday et al., 2020). Insulin resistance occurs as a result of cell pathway disruption which decreases the sensitivity of cells in the muscle, adipose and liver tissues toward insulin. This decreased insulin sensitivity prompts beta-cells to hyperfunction to compensate for the decreased insulin (Banday et al., 2020). However, the beta-cells cannot supplement the insulin sensitivity enough and their function starts to decline, therefore, eventually leading to hyperglycemia. Gestation diabetes is any level of glucose intolerance or diabetes which is diagnosed during pregnancy. Lastly, other types of diabetes can be caused by defects in beta-cell function in the body (Banday et al., 2020).

Pancreatic beta cells make and release insulin which maintains blood glucose levels at optimal levels. The pancreas is made up of endocrine and exocrine parts, with the exocrine section being composed of acinar cells and the endocrine section being composed of islets of Langerhans (P. Khin et al., 2023). The islets of Langerhans are made up of alpha, beta and epsilon cells. These cells release insulin, glucagon, ghrelin and somatostatin. Beta cells comprise 65-80% of the cells here. It is important to note that the islets of Langerhans are the only place where insulin is secreted (P. Khin et al., 2023) Diabetes develops and progresses mostly because

of defects in the mass and function of β-cells (P. Khin et al., 2023). At first, beta-cells can adapt to initial insulin resistance but eventually, they get tired and beta-cell mass depletes.

Insulin is required for regulating blood glucose homeostasis. Insulin does this by signalling to the muscle, liver and fat cells to increase their glucose intake- this reduces blood glucose (P. Khin et al., 2023). As insulin activity decreases or deficiency continues, hyperglycemia occurs. Subsequently, as the beta-cell function continues to decline and there is a substantial decrease in the production and release of insulin, diabetes mellitus develops (Cerf, 2013). Focusing on type 2 diabetes, figure 1 shows how the pancreatic beta cells are damaged cumulatively by hyperlipidemia, hyperglycemia, amyloids and cytokines. Even though the beta cells create insulin they cannot create enough to compensate for insulin resistance. This leads to insulin deficiency and hyperglycemia (P. Khin et al., 2023).

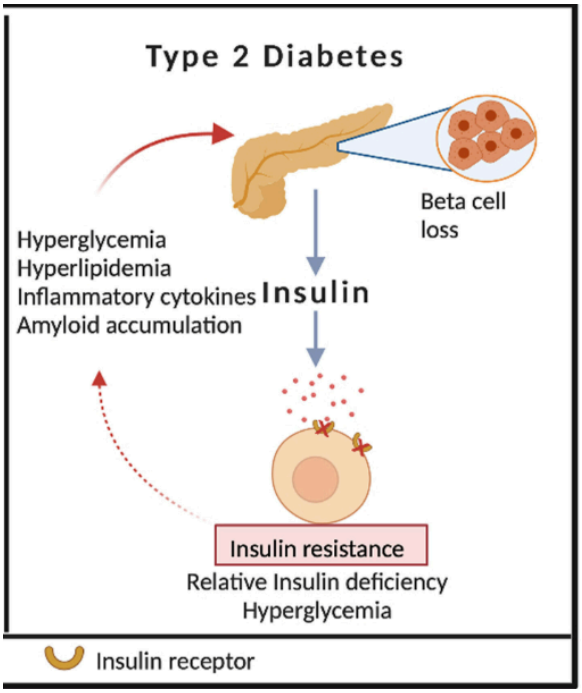

Figure 1. Diagram of the effects of beta cell loss on insulin resistance

When we consume food, the carbohydrates are broken down into glucose. This glucose enters the beta-cells through the glucose transporter on the plasma membrane, it then prompts insulin release (Matschinsky & Wilson, 2019). Glucose is phosphorylated inside the beta-cell to glucose-6-phosphate (G6P) by glucokinase. G6P can now make pyruvate via glycolysis, pyruvate can enter the mitochondria. It is oxidized to ATP here through the tricarboxylic acid cycle, this process raises the intracellular ATP/ADP ratio (Martínez-Reyes & Chandel, 2020). This in turn causes the ATP-dependent potassium channel to close. Now the plasma membrane is depolarized and potassium cannot exit the beta-cell (*Secretion of Insulin in Response to Diet and Hormones*, 2016). As a result, an influx of Ca2+ enters the cell, which triggers exocytosis of insulin granules (H. & Thorn, 2015; *Secretion of Insulin in Response to Diet and Hormones*, 2016). This process can be seen in Figure 2 below.

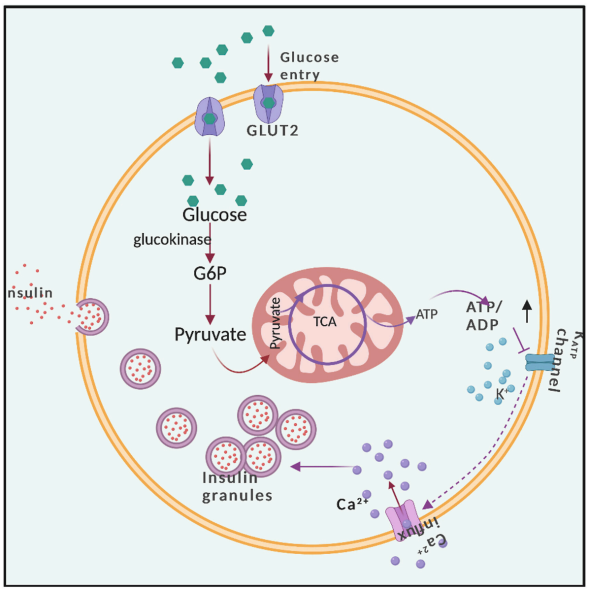

Figure 2. Process of how glucose is processed into insulin creation.

The role of beta-cell failure in type 2 diabetes is complex. We know that beta cells control insulin secretion as a response to glucose concentration. In diabetic patients, these beta-cells are unable to release enough insulin in response to the rise in insulin demon from glucose and secretagogues (Remedi et al., 2016). Type 2 diabetes typically begins with decreased insulin secretion with a large majority of beta-cell mass being lost before the onset of disease (Swisa et al., 2017). Cells are likely to differentiate into other islet cells. Stressed β-cells in diabetes undergo a dedifferentiated condition from their mature differentiated state by a decrease in β-cell-enriched genes that govern normal β-cell activities, namely GLUT2, PDX1, FOXO1, and MafA (Liu et al., 2020).

Beta-cell deficiencies are caused by three main factors: glucose toxicity, lipotoxicity, and glucolipotoxicity (Weir, 2020). Continuous exposure to high glucose levels results in beta-cell suppression, decreased insulin production, and death. Short-term exposure can promote beta-cell proliferation (Donath et al., 1999). Prolonged exposure to high free fatty acid levels also damages beta-cell function; nevertheless, triglyceride buildup prevention can be beneficial (Huang et al., 2021; Prentki et al., 2020; Rorsman & Ashcroft, 2018). Elevated amounts of free fatty acids in the bloodstream, particularly when hyperglycemia is present, exacerbate beta-cell malfunction and death in individuals with diabetes (Donath et al., 1999). Sustaining appropriate β-cell activity is essential to fulfil metabolic requirements.

Beta-cell dysfunctions causing diabetes can occur for a number of reasons. Namely; mitochondrial dysfunction and oxidative stress, ER stress or impaired autophagy. Pancreatic β-cell mitochondria affect insulin secretion and glucose metabolism (Supale et al., 2012). They produce reactive oxygen species (ROS), and mitochondrial abnormalities cause diabetes, metabolic diseases, and β-cell death. When STING detects damage to mitochondrial DNA, β-cell

apoptosis is activated. In hyperglycemia, the failure of β-cells is a result of a reduction in mitochondrial metabolism (Hu et al., 2020). β-cell malfunction and death are caused by ROS imbalance and oxidative stress. Antioxidants that target mitochondria might be a promising treatment. Additional investigation is required as mitochondrial network fragmentation, which is governed by redox signalling and associated with β-cell death (P. Khin et al., 2023).

Autophagy is essential for how a cell operates. When dysfunctional in Type 2 Diabetes (T2DM), it affects the pancreatic beta-cells ability to regulate. Unbalanced autophagy leads to more waste vacuoles building and hinders the necessary lysosomal materials (Chun & Kim, 2018). Under pressures like oxidative or endoplasmic reticulum stress, a weakened autophagy results in increased beta-cell anguish and compromised insulin emission. Steady autophagy oversight is key for beta-cell survival and performance. Enhancing autophagy could possibly be a treatment for T2DM (Blandino-Rosano et al., 2017). Ginsenoside Rg2 and TonEBP display promise in bettering insulin sensitivity. Additional analysis is needed on how autophagy boosters influence beta-cell death and malfunction (Fan et al., 2017).

An essential ER implicated in insulin production is present in pancreatic β-cells. ER stress can be brought on by inflammation, excessive hyperglycemia, and amyloid buildup, among other things (Kataoka & Noguchi, 2013). Insulin resistance can be alleviated by using sodium butyrate to inhibit the PERK-CHOP pathway. ER stress is induced by PDX1 decrease in glucotoxicity or lipotoxicity. Tectorigenin increases the expression of PDX1, which protects β-cells (Yao et al., 2020). In β-cells, palmitate causes ER stress and inflammation. Antioxidant defences are strengthened by perilipin 5. Further investigation is needed into the functions of PLIN2 and PLIN5 in lipotoxicity-induced ER stress (Zhu et al., 2020)

GLUT2 and GLUT 4 play important roles in controlling blood glucose levels and in the functioning of diabetes. GLUT 2 is located in the liver and in pancreatic beta cells. In the liver it helps to control glucose uptake and release (Navale & Paranjape, 2016). When blood glucose levels peak, the transporter lets the liver absorb excess glucose and store it is glycogen. Oppositely, when blood glucose levels drop, the stored glucose is released into the bloodstream. In the pancreatic beta cells GLUT 2 senses glucose by monitoring blood glucose levels and releasing insulin in response to this (Navale & Paranjape, 2016). GLUT 4 is found in the skeletal muscle and in adipocytes. It is known as an insulin-responsive glucose transporter- when there is no insulin it is called into the intracellular vesicles. When insulin is released it moves to the cell membrane where it can absorb glucose into muscle and fat cells. In those with diabetes, as we know there is less of an insulin response therefore GLUT 4 does not work as effectively (Navale & Paranjape, 2016).

When a person has type 1 diabetes, their immune system targets and kills the beta cells in their pancreas that are in charge of making insulin (Alam et al., 2016). The function of GLUT2 in glucose sensing and control in the liver and pancreas is impacted by this reduction in insulin synthesis. Insulin resistance is common in fat and muscle cells in type 2 diabetes, which reduces GLUT4's sensitivity to insulin signals. Because of this illness, these cells are unable to absorb glucose as efficiently, which raises blood sugar levels (Alam et al., 2016)**.**

Type 2 Diabetes: Comorbidities

Type 2 diabetes makes up the majority of diagnosed cases. For the purpose of this literature review, I will be focusing on type 2. In 2009, 2.4 million Canadians were diagnosed with diabetes, with an estimated increase of 50% by 2025 (Diabetes Canada, 2016). As

mentioned above, this type of diabetes is caused by beta-cell dysfunction and insulin resistance. Both of these lead to hyperglycemia. Having type 2 diabetes comes with an increased risk of developing certain comorbidities. The most common of these are hypertension and obesity.

In the US approximately 75% of adults with diabetes are also diagnosed with hypertension (CDC, 2007). The complications that lead to hypertension as a comorbidity are largely because of macrovascular and microvascular conditions. These macrovascular conditions include; myocardial infarction, coronary heart disease, peripheral vascular disease, congestive heart failure and stroke. Microvascular complications include; nephropathy, retinopathy and neuropathy. The main cause of blindness that is not congenital in the US is diabetes related. Additionally, the majority of amputations in the US are a result of foot ulcers and peripheral artery disease from diabetes.

Hypertension

Damage from diabetes results in kidney scarring, which exacerbates hypertension by causing retention of salt and water (New York- Presbyterian). Diabetes causes damage to the tiny blood arteries over time, stiffening and impairing their ability to function. These alterations are a factor in hypertension (New York- Presbyterian). There are three pathophysiological changes that lead to hypertension as a result of diabetes. These are; elevated intravascular volume, autonomic nervous system dysregulation and RAAS.

An imbalance between sodium loss and consumption can cause a positive sodium balance, which raises the intravascular volume and elevates arterial pressure and cardiac output (Naha et al., 2021). Furthermore, increased vascular stiffness and higher blood pressure in obesity and insulin resistance—a condition commonly observed in type 2 diabetic patients—are caused by excessive salt inward transport in endothelial cells (Hill et al., 2021). Pressure

natriuresis is used to counteract high blood pressure that occurs as a result of intravascular expansion. Unfortunately, this method is insufficient to successfully lower blood pressure that remains elevated over time, particularly in those suffering from chronic kidney disease (CKD) and end-stage renal disease (ESRD). As a result of changes to the glomerular apparatus and renal microvasculature, salt reabsorption is increased and filtration is decreased (Hill et al., 2021; Van Buren & Toto, 2013).

Blood pressure control is greatly dependent on the autonomic nerve system. The neural systems that control blood pressure are the parasympathetic and sympathetic branches (Naha et al., 2021). Elevated blood pressure is caused by a wide variety of factors- increased sympathetic activity, heart rate, forceful ventricular contractions, fluid retention, and peripheral vascular resistance. However, a reduction in parasympathetic activity can also raise heart rate (Naha et al., 2021). This intensifies sympathetic hyperactivity and increases blood pressure. Hypertension can come about as a result of disturbances to these pathways (Naha et al., 2021).

RAAS plays an important role in controlling blood pressure. It also plays an important role in the pathophysiology of hypertension as it raises plasma aldosterone levels and the effect they have on the heart and kidneys. Additionally, angiotensin II stimulates aldosterone secretion which in turn leads to water and sodium retention- leading to increased blood pressure via volume expansion (Naha et al., 2021). When there is hypovolemia-induced renal hypoperfusion, RAAS is physiologically activated. Angiotensin II production rises as a result of a series of processes triggered by the release of renin from the juxtaglomerular apparatus. Following direct vasoconstriction, angiotensin II increases blood pressure via stimulating aldosterone release, which causes salt and water retention and restores intravascular volume (Hill et al., 2021).

Obesity

As body mass index increases, the risk of type 2 diabetes increases linearly. This relationship can be explained by the involvement of adiposity-induced changes in beta cell function, insulin resistance and adipose tissue biology (Klein et al., 2022). Compared to people with a lower body (gluteofemoral) fat phenotype, obese individuals with a predominant increase in upper body fat (abdominal subcutaneous and intra-abdominal fat), intrahepatic triglyceride content, intramyocelluar lipid content, and pancreatic fat are more likely to develop type 2 diabetes (Klein et al., 2022). Indeed, in individuals who are lean, overweight, or obese, increased gluteofemoral body fat mass is linked to lower plasma triglyceride and higher HDL-cholesterol concentrations, lower fasting blood glucose and insulin concentrations, higher insulin sensitivity and oral glucose tolerance, and a lower risk of type 2 diabetes (Klein et al., 2022).

Insulin is secreted by pancreatic beta-cells straight into the portal vein, where it is mostly cleared by the liver. The ratio of insulin production to insulin clearance by the liver and extrahepatic tissues determines the concentration of insulin in plasma (Klein et al., 2022). One important factor that determines whether obese individuals acquire type 2 diabetes is the activity of their pancreatic beta-cells. Individuals with obesity who do not have type 2 diabetes usually have higher plasma insulin concentrations and secrete more insulin during baseline circumstances and after consuming glucose than those who are lean (Klein et al., 2022). Oral glucose tolerance and fasting blood glucose concentration can return to normal when insulin resistance is reversed by an increase in insulin secretion rate and plasma insulin concentration. But as beta-cell activity progressively deteriorates, glycemic control progressively deteriorates as well, leading to prediabetes and eventually type 2 diabetes (Klein et al., 2022).

Under typical circumstances, plasma-free unsaturated fats are the essential fuel hotspot for skeletal muscles. In any case, after the utilization of glucose, the ascent in plasma insulin levels restrains fat tissue fatty substance breakdown, decreasing plasma-free unsaturated fat levels (Klein et al., 2022). This insulin flood likewise advances the take-up of glucose by muscle cells, moving the muscle's essential fuel source from unsaturated fats to glucose. This interaction includes insulin restricting to muscle cell insulin receptors, setting off a progression of intracellular occasions prompting the movement of glucose carrier 4 to the cell layer for glucose take-up (Klein et al., 2022). Inside the myocyte, glucose is quickly phosphorylated and can be either oxidized through glycolysis or stored as glycogen. In most cases, 30% of ingested glucose is taken up by skeletal muscle, with half being oxidized, 35% put away as glycogen, and 15% going through non-oxidative glycolysis (Klein et al., 2022). Weight and type 2 diabetes frequently lead to disabled muscle glucose oxidation and glycogen blend because of issues with insulin receptors and flagging. Also, conditions like weight and type 2 diabetes are related with changes in muscle lipid appropriation and digestion, adding to insulin obstruction (Klein et al., 2022).

Treatment: Lifestyle Changes

When a person is diagnosed with diabetes sometimes healthcare professionals will start with non-medical lifestyle changes instead of putting them on metformin. Some of these lifestyle changes include being educated on their condition, physical activity, weight management, nutrition and stress management. Exercise plays a big role in the management of diabetes. It has been proven that moderate to high levels of physical activity and cardiorespiratory fitness lead to considerably lower morbidity and mortality (Sigal et al., 2018). Exercise can lead to improved

glycemic control, improved lipid profile, blood pressure reduction, decreased insulin resistance and weight loss maintenance (Sigal et al., 2018).

Lifestyle changes and non-pharmacological ways to treat diabetes are the first steps to a healthy lifestyle. An abundance of evidence shows that lifestyle changes- healthy diets, exercise and a reduction in body weight- can delay or even prevent diabetes onset among high-risk individuals (Galaviz et al., 2018). If an individual can manage, delay or prevent their diabetes without the need for insulin and other diabetes drugs- this is the way healthcare professionals want to go. Putting an individual on medication for their condition is generally a last line of defence. Additionally, lifestyle changes do not require individuals to spend time in hospitals/clinics allowing them to manage patients and patient overflow better.

The recommended amount is 150 minutes of aerobic exercise per week. For those with type 2 diabetes exercise programs have been shown to improve glycemic control and reduce to need for medication (Sigal et al., 2018). A meta-analysis done by Umpierre et al. (2011) found that those who participated in supervised exercise saw improvements in their A1C levels. Additionally, those who participated in more than 150 minutes of exercise per week saw significant improvements in their A1C levels compared to those who did less than this (Umpierre et al., 2011). On top of this, it has been shown to decrease BMI, total cholesterol levels and TG (MacMillan et al., 2014; Quirk et al., 2014).

The best types of exercise for diabetes management are interval training, resistance training and aerobic exercise. Short bursts of higher- and lower-intensity exercise are alternated with high-intensity interval training (Sigal et al., 2018). When compared to continuous moderate-intensity exercise, high-intensity interval training improves glucose management and increases cardiorespiratory fitness in both individuals with and without diabetes (Sigal et al.,

2018). It was found that high-intensity interval training twice a week reduced abdominal and visceral fat whereas continuous aerobic exercise did not.

Those with type 2 diabetes who practice resistance training see an improvement in glycemic control, increased muscular strength, lean muscle mass, bone mineral density and decreased insulin resistance (Sigal et al., 2018). The best results for diabetes management through resistance training come from 3 sets of resistance training with 8 reps in each at moderate to high intensity. Additionally, the greatest reduction in A1C and body fat is achieved through resistance training twice weekly in conjunction with aerobic activity (Sigal et al., 2018).

Aerobic exercise is the most studied exercise for the management of diabetes. It includes continuous movements involving large muscle groups. The recommendation for the best results is 30 minutes per day for 3 to 7 days per week (Kirwan et al., 2017). Exercise in these times should be moderate to vigorous, if this is achieved cardiac output will be improved. This in turn will reduce cardiovascular risk and mortality in those with type 2 diabetes. This type of exercise is an effective way to improve A1C levels and support weight loss. (Kirwan et al., 2017).

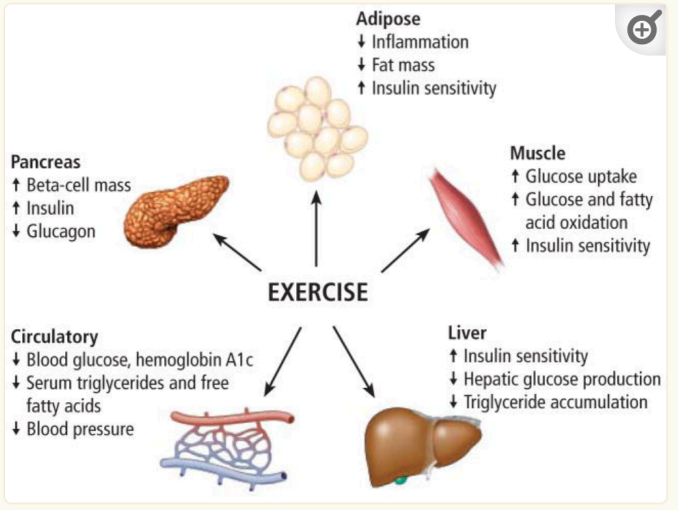

Figure 3. Diagram showing how exercise affects the major organs that are affected by diabetes.

Exercise is important for the management of diabetes for a number of reasons. The skeletal muscle is the main site for glucose uptake and disposal. Peripheral insulin resistance that comes from the skeletal muscle plays a major role in the progression and development of type 2 diabetes (Hawley et al., 2006). Exercise increases muscle glucose uptake by using insulin-dependent and independent mechanisms. Exercise assists in these processes. Acute exercise sessions can also temporarily boost skeletal muscle's absorption of glucose by up to five times through enhanced (insulin-independent) glucose transport (Magkos et al., 2008). Increased insulin sensitivity gradually takes the place of this short-lived impact, and with time, these two exercise-induced adaptations improve skeletal muscle's insulin responsiveness and sensitivity (Holloszy, 2005). It has been demonstrated that aerobic exercise increases the number of skeletal muscle mitochondria and oxidative enzymes, which leads to significant gains in the oxidation of fat and glucose and elevated expression of insulin-signalling proteins (Mulya et al., 2017).

Exercise has many positive effects on adipose tissue- increased insulin sensitivity, a reduction in fat mass and decreased inflammation (Dandona et al., 2003). Exercise has been proposed as a means of suppressing cytokine production through enhanced adipocyte activity and decreased inflammatory cell infiltration. Exercise significantly lowers levels of the important pro-inflammatory marker C-reactive protein, and it has been demonstrated that various exercise modalities normalize adipokine signalling and associated cytokine release (Balducci et al., 2010; Jorge et al., 2011). Additionally, resistance training reduced visceral and subcutaneous fat mass in those with type 2 diabetes (Ibañez et al., 2005).

Nutrition also plays a very important role in diabetes management. It is suggested by most healthcare professionals that people with diabetes should be getting nutrition counselling from a dietitian (Sigal et al., 2018). A number of different researchers have found that nutrition

therapy can reduce A1C by 1-2% and improve glycemic control when used in conjunction with other types of diabetes care (Gaetke et al., 2006; Kulkarni et al., 1998; Marion J. Franz et al., 1995; Pastors et al., 2002; Pi-Sunyer et al., 1999). The main strategy in using nutrition for diabetes management is energy restriction with the goal of weight loss (Wing, 2000). Weight loss of 5% to 10% can improve insulin sensitivity, dyslipidemia and glycemic control in those with type 2 diabetes (Tuomilehto et al., 2001; William C. Knowler et al., 2002; Wing et al., 2010). An individual's nutrient management will be tailored to their needs by their dietitian. They will suggest recommended amounts of carbohydrates, dietary fibre, sugars, fats and proteins to promote weight loss or management.

There are also recommended diets that would be beneficial to those trying to lose weight with the goal of managing their diabetes, some of these include; the Mediterranean diet, a vegetarian diet, DASH or other low sodium diets, the portfolio diet, the Nordic diet (Sigal et al., 2018). The Mediterranean diet is characterized by cooking seasonally and locally, focusing on vegetables, whole grain foods, legumes, seeds, nuts, fruit low dairy consumption and moderate protein consumption (Martín-Peláez et al., 2020). It has been found that following the Mediterranean diet decreases the risk of type 2 diabetes by 23% (Koloverou et al., 2014). A vegetarian diet is described as not consuming meat, poultry or fish (Martín-Peláez et al., 2020). A vegetarian diet can reduce the risk of developing type 2 diabetes by 35% (Tina H. T. Chiu et al., 2018). The DASH diet aims at reducing sodium intake and increasing vegetable, fruit and low-fat dairy consumption (Martín-Peláez et al., 2020). Similar to the Mediterranean diet, the DASH diet saw a 20% reduction in the risk of being diagnosed with type 2 diabetes (Esposito et al., 2014).

The portfolio diet follows a plant-based pattern, it is known to reduce LDL cholesterol and other CVD risk factors (Andrea J. Glenn et al., 2022). A follow-up study over 16 years found that following this diet leads to a decreased incidence of type 2 diabetes (Andrea J. Glenn et al., 2022). Lastly, the Nordic diet is a diet comprised of whole grains, fruits and berries, vegetables, rapeseed oil, fish, low-fat dairy and low alcohol and processed meat consumption (Kanerva et al., 2014). Serum insulin concentration was shown to be enhanced by a nutritious Nordic diet, according to a meta-analysis of randomized controlled studies (Zimorovat et al., 2020). A nutritious Nordic diet has also been demonstrated to enhance insulin responsiveness and fasting glucose levels, even when body weight fluctuations are taken into account (Trimigno et al., 2020).

Diets associated with a lower risk of type 2 diabetes tend to be related to helping to reduce hypertension in these individuals. Namely, the DASH diet promotes a reduction in blood pressure due to its guidelines of eating foods that are low in fat, cholesterol and sodium. Similarly, a vegetarian diet shows the same results. In general, these diets promote a healthy lifestyle that leads an individual to lose weight and lower their blood pressure. Both are major comorbidities in those with type 2 diabetes and treating these conditions will improve the quality of life of patients.

On top of the physical manifestations of disease associated with diabetes, diabetes-induced stress can make management of the disease difficult (Stratton et al., 2000). Psychotherapy can help to reduce the need for costly medical services and improve mental health (Shapiro et al., 2005). Stress can cause the release of counterregulatory hormones and energy mobilization, which sometimes leads to elevated glucose levels (Landsberg, 2008; Surwit & Schneider, 1993). On top of this, stress can interfere with the way patients can effectively care

for their diabetes. This type of stress can be controlled through psychotherapy or medications- both have been proven to better glycemic control in type 2 diabetes patients (Lehrer et al., 1994; Lustman et al., 1995; Lane et al., 1993). A study done by Surwit et al. (2002) found that type 2 diabetes patients who attended outpatient stress management training saw a 0.5% reduction in A1C after 1 year when compared to the control patients.

Treatment: Pharmacological Interventions

Insulin

In type 2 diabetes weight loss has been proven to be an effective strategy to improve insulin secretion in those who are overweight or obese (Patel & Keyes, 2023). Nutrition and exercise are the two best ways for patients suffering from diabetes to achieve weight loss and improve their health. This can be difficult as many of the medications prescribed to those with diabetes promote weight gain; antidepressant agents, pain relief, antihyperglycemic and antihypertensive (Hollander, 2007).

As mentioned before, these lifestyle changes are either used as a first line of treatment or in conjunction with medications or other medical interventions. There are many different types of medications for treating diabetes and it differs with the type of diabetes one has. Those with type 1 diabetes will need to take insulin via an insulin pen, syringe or pump. Those with type 2 diabetes are able to control their blood glucose levels by changing aspects of their lifestyle. However, sometimes people with type 2 diabetes need to take insulin too.

Insulin is a polypeptide hormone that is found in the islets of Langerhans of the pancreas and released by beta cells (Rahman et al., 2021). Insulin controls glucose levels and stimulates glucose storage in the liver, adipose tissue and muscles. It works by binding directly to its

receptors on cell plasma membranes. An insulin receptor is a heterotetrameric glycoprotein with alpha and beta subunits (Kahn, 1985). The alpha subunits are extracellular and hold the insulin binding sites. The beta subunits are transmembranous and have tyrosine kinase activity (Kahn, 1985). Insulin binds to the alpha subunit and activates the tyrosine kinase activity of the beta subunit (Posner, 2017). This causes glucose transporters to translocate to the cytoplasm from the cell's surface (Jaldin-Fincati et al., 2017).

There are many different types of insulin, how long they take to work and how long they last varies. There are three main categories for insulin: Bolus, Basal and Premixed. Bolus insulins are broken down into Rapid-acting and Short-acting insulin. Rapid-acting Bolus insulin has an onset of 4-20 minutes depending on the brand and a duration of 3-5 hours (Diabetes Canada, 2018). Short-acting Bolus insulin has an onset of 15-30 minutes depending on the brand and a duration of 6.5-24 hours. Basal insulins also have two types; intermediate-acting and long-acting (Diabetes Canada, 2018). Intermediate-acting Basal insulins have an onset of 1-3 hours and last up to 18 hours. Long-acting Basal insulin has an onset of 9- minutes and lasts between 16-30 hours (Diabetes Canada, 2018). Premixed insulins can be either regular or analogous. Premixed regular insulin is a single cartridge or vial with a fixed insulin ratio (Diabetes Canada, 2018). Premixed insulin analogues have a percentage of rapid/short-acting insulin to a percentage of intermediate-acting insulin (Diabetes Canada, 2018).

Types of insulin			
Insulin type (trade name)	**Onset**	**Peak**	**Duration**
Bolus (preprandial or mealtime) insulins			
Rapid-acting insulin analogues (clear) • Insulin aspart (NovoRapid®) • Insulin glulisine (Apidra®) • Insulin lispro (Humalog®) U-100 U-200 • Faster-acting insulin aspart (Fiasp®)	 9–20min 10–15min 10–15min 4min	 1–1.5h 1–1.5h 1–2h 0.5–1.5h	 3–5h 3.5–5h 3–4.75h 3-5h
Short-acting insulins (clear) • Insulin regular [Humulin®-R, Novolin® ge Toronto] • Insulin regular [Entuzity® (U-500)]	 30min 15min	 2–3h 4-8h	 6.5h 17-24h
Basal insulins			
Intermediate-acting (cloudy) • Insulin neutral protamine Hagedorn (Humulin® -N, Novolin® ge NPH)	1–3h	5–8h	Up to 18h
Long-acting insulin (clear) • Insulin detemir (Levemir®) • Insulin glargine U-100 (Lantus®) • Insulin glargine U-300 (Toujeo®) • Insulin glargine biosimilar (Basaglar®) • Degludec U-100, U-200 (Tresiba®)	90min	Not applicable	U-100 glargine 24h, detemir 16–24h U-300 glargine >30h degludec 42h
Premixed insulins			
Premixed regular insulin –NPH (cloudy) • Humulin® 30/70 • Novolin® ge 30/70, 40/60, 50/50	A single vial or cartridge contains a fixed ratio of insulin		
Premixed insulin analogues (cloudy) • Biphasic insulin aspart (NovoMix® 30) • Insulin lispro/lispro protamine (Humalog® Mix25 and Mix50)	(% of rapid-acting or short-acting insulin to % of intermediate-acting insulin)		
Data represents estimations derived from pooled data analysis using various experimental conditions. There is significant inter- and intra-individual variation in pharmacokinetics and pharmacodynamics depending on a variety of clinical factors, including dose. Physicians should refer to the most current edition of *Compendium of Pharmaceuticals and Specialties* (Canadian Pharmacists Association; Ottawa, Ontario, Canada) and product monographs for detailed information.			

Table 1. Different types of insulin including their onset, peak and duration of action.

Metformin

There are three main types of drugs prescribed in typical diabetes care presently. These are metformin, GLP1-RAs and SGLT2is. Metformin is generally the first drug to be prescribed after lifestyle interventions in those with type 2 diabetes. If a patient's A1C levels are less than 9% metformin is recommended. However, if their A1C is greater than 9% combination treatment is the next step (“Pharmacologic Approaches to Glycemic Treatment: Standards of Medical Care in Diabetes—2018,” n.d.). Metformin disrupts gluconeogenesis- this is how the liver makes glucose from non-glucose precursors (Wulffelé et al., 2002). This declines intestinal absorption and amplifies insulin sensitivity (Corcoran & Jacobs, 2023).

Effects are mediated by the stimulation of liver kinase B1 (LKB-1) which regulates the downstream kinase adenosine monophosphatase protein kinase (AMPK) (Shaw et al., 2005). This reduces the amount of blood sugar being produced in the body- treating hyperglycemia.

Transducer of regulated CREB protein 2 (TORC2) is a transcriptional co-activator that AMPK phosphorylates. This leads to its inactivation, which in turn downregulates transcriptional processes that stimulate the production of gluconeogenic enzymes (Shaw et al., 2005). It has also been suggested that inhibition of mitochondrial respiration, which lowers the energy supply needed for this activity, contributes to the decrease in gluconeogenesis. This drug is correlated with a reduction in weight gain, along with a reduced insulin requirement (Wulffelé et al., 2002). How metformin accomplishes this is still not clear and research is ongoing.

GLP1-RAs

GLP1-RAs work by increasing glucose-dependent insulin release, slowing gastric emptying and inhibiting glucose release (Lipscombe et al., 2020). It does this by assisting the pancreas in releasing the correct amount of insulin when blood sugar levels are high. Additionally, the drug works with part of the brain that suppresses your appetite and makes you feel full (Lipscombe et al., 2020). Within minutes of consuming nutrients, K cells in the small intestine and L cells in the distal ileum and colon, respectively, secrete glucose-dependent insulinotropic polypeptide (GIP) and GLP-1, peptide hormones known as incretins. These incretins interact with islet beta-cells through GLP-1 and GIP receptors (Shaefer et al., 2015). Activation of incretin receptors on pancreatic β-cells results in glucose-dependent insulin secretion; after an oral glucose load, incretins released from the gastrointestinal tract account for 50% to 70% of total insulin secretion (Shaefer et al., 2015). However, only GLP-1 slows stomach emptying and inhibits glucagon release in a glucose-dependent manner to carry out other glucoregulatory functions. In addition to promoting fullness, GLP-1 also activates GLP-1 receptors, which are linked to weight reduction (Shaefer et al., 2015). The GLP-1 receptor is found in many other tissues in the body, this allows its effects to be felt all around the body.

These processes are not properly carried out in those with type 2 diabetes. Pharmacological administration of GLP-1 can restore this function and increase insulin response. GLP-1RAs lower glucose levels in 4 main ways. Firstly, it enhances the release of glucose-dependent insulin from the pancreatic beta-cells (Shaefer et al., 2015). In a glucose-dependent manner, the binding of GLP-1 to its receptor on pancreatic β-cells promotes the release of insulin. Moreover, GLP-1RAs boost translational glucose-induced insulin production, preserving β-cell insulin reserves and secretory ability (Shaefer et al., 2015). Secondly, they decrease endogenous glucose production. They do this through direct effects on alpha cells, here these cells have an increased sensitivity to glucose and release less glucose. Suppression of glucagon reduces the amount of glucose generated by the liver, which lowers the amount of insulin required and further enhances glucose management because glucagon increases hepatic glucose synthesis. Furthermore, GLP-1RAs could influence peripheral glucose metabolism through the CNS's GLP-1 receptors (Shaefer et al., 2015).

Thirdly, stimulation of GLP-1 receptors by GLP-1RAs centrally has been shown to reduce food intake and increase energy use by brown adipose tissue and white adipose tissue browning. Studies have also shown that there is an increase in energy use in those who have been treated for 1 year (Shaefer et al., 2015). Lastly, GLP-RAs can inhibit pentagastrin, meal-stimulated gastric emptying and gastric secretion. This effect is controlled by the vagus nerve and involves GLP-1 receptors which are found in the CNS and/or vagal afferent fibres that communicate sensory information to the brain (Shaefer et al., 2015).

SGLT2is

Sodium/glucose cotransporter-2 inhibitors (SGLT2i) are a newer type of drug that lowers glucose. It does this by stopping its reabsorption in the proximal tubules and promoting urinary glucose excretion (Ni et al., 2020). Two membrane-associated transporters—the glucose transporter (GLUT) and SGLT (SGLT1 and SGLT2)—are necessary for the entrance of glucose into eukaryotic cells. Whereas GLUT moves glucose along the concentration gradient in a manner that promotes diffusion, SGLT moves glucose against the gradient by active transport (Ni et al., 2020). The focus is on the most significant members, SGLT1 and SGLT2, which are associated with glucose transport. High-affinity, low-volume membrane transporter SGLT1 is primarily expressed in the small intestine and renal proximal tubule (S3 segment); in contrast, low-affinity, high-volume membrane transporter SGLT2 is virtually exclusively expressed in the S1 section of the renal proximal tubule (Ni et al., 2020). SGLT2 is responsible for 90% of glucose reabsorption, while SGLT1 is responsible for the remaining 10% (Ni et al., 2020).

In order to effectively inhibit the activity of SGLT2 in renal proximal convoluted tubules, reduce glucose reabsorption by renal tubular epithelial cells, promote urine glucose excretion, and have glucose-lowering effects, the aglycones of SGLT2i can bind competitively to glucose transporters (Ni et al., 2020). Along with improving renal tubuloglomerular feedback, lowering renal hyperfiltration, lowering sodium and glucose toxicity in the proximal tubule, and raising urinary sodium concentrations in the distal ends of the proximal convoluted tubule and distal tubule, SGLT2i can also inhibit sodium reabsorption in renal tubules (Ni et al., 2020). For SGLT2i to have pharmacological effects in vivo, they do not require insulin or islet beta-cells. These inhibitors have the ability to lower blood glucose and glycosylated hemoglobin while

simultaneously enhancing islet beta-cell activity and lowering the body's insulin production (Ni et al., 2020).

Newer Diabetes Drugs

Newer GLP-1 Drugs

As research in regard to diabetes treatment continues, newer drugs are being developed and tested. Some of these include semaglutides like Ozempic, danuglipron, retatrutide, tirzepatide and cagrilintide. The most popular of them is Ozempic, approved in 2018 and is a GLP-1 type drug. It can be used in combination with metformin or insulin. As mentioned above GLP-1 drugs work by assisting the pancreas in releasing the correct amount of insulin when blood sugar levels are high. It also works with part of brain that suppresses your appetite and makes you feel full. Danuglipron is also a GLP-1 type drug. It works by increasing the amount of insulin released and lowering glucagon levels in the blood. Additionally, it slows digestion and increases fullness after eating. This drug is not yet FDA approved and is currently being studied to improve glycemic control in those with type 2 diabetes.

Triple G Agonists

Triple G agonists (GLP1-GIP-GCG) are the newest type of diabetes drug on the market. G-protein-coupled receptor peptides, or incretins, are gut-secreted hormones that include glucagon (GCG), gastric inhibitory polypeptide (GIP), and glucagon-like peptide 1 (GLP-1). Regarding decreased appetite, increased energy expenditure, nutrient storage and substrate utilization, insulin secretion, promotion of satiety, delayed gastric emptying, or decreased systemic inflammation, each of these three incretins has somewhat different effects, both at the gut level and via the brain. Retatrutide is a triple-G agonist drug. It mimics GLP1, GIP and GCG,

by doing this it stimulates insulin release, increases fullness after eating and delays gastric emptying.

GLP-1-GIP

Tirzepatide better known by its brand name Mounjaro is a GLP-1-GIP drug- approved in 2022. It works by activating GIP and GLP-1 receptors. By doing this it decreases food intake and modulates fat utilization. Additionally, it stimulates insulin release and increases adiponectin levels (Farzam & Patel, 2023). Tirzepatide is a synthetic peptide that functions as a dual agonist for the glucagon-like peptide 1 (GLP-1) receptor and the gastric inhibitory polypeptide (GIP). It is an analogue of the gastric inhibitory polypeptide and consists of 39 amino acids (Bingfa Sun et al., 2022). Its functional effect is to lower hyperglycemia by inducing the pancreas to produce more insulin. Furthermore, adiponectin levels are likewise elevated by tirzepatide. Because of its dual agonist properties, it reduces hunger and significantly decreases hyperglycemia compared to GLP-1 agonist medications alone (Bingfa Sun et al., 2022).

GLP1-Amylin

Cagrilintide is a GLP1-Amylin-type drug, that is not FDA-approved. It works by targeting calcitonin receptors and the GLP1R receptor. By doing this it controls fullness after eating and blood glucose control via insulin stimulation. These medications function similarly to the natural hormone GLP-1, which the intestines produce in reaction to meal consumption. By promoting the production of insulin and preventing the release of glucagon, another hormone that elevates blood sugar levels, GLP-1 aids in blood sugar regulation. This lowers blood sugar levels and increases feelings of fullness, both of which are beneficial for managing weight (Kruse et al., 2021). Another hormone that the pancreas produces and which aids in controlling blood sugar levels is amylin. Synthetic forms of amylin known as "amylin analogues" are a

useful addition to insulin or other diabetic drugs. These medications reduce the speed at which food is absorbed and processed, so reducing blood sugar increases that occur after meals. An example of an amylin analogue is pramlintide, often known as symlin (Kruse et al., 2021).

Drug	Date Approved	Brand Names	Type	What it does	How it works	Effectiveness
Semaglutide	2018	Ozempic Rybelsus Wegovy	GLP-1	Blood sugar control	Assists pancreas in releasing the correct amount of insulin when blood sugar levels are high. Also works with part of brain that suppresses your appetite and makes you feel full.	After 6 months HbA1C was down 0.9%
Danuglipron	Not FDA approved		GLP-1	Blood sugar control	Increase amount of insulin released and low glucagon levels in the blood. Slow digestion and increase fullness after eating	After 16 weeks 30-65% have HbA1C less than 7%
Retatrutide	Not FDA Approved		GLP1-GIP-GCG	Weight reduction, blood sugar control and brain effects	Mimics GLP1, GIP and GCG. Increases insulin release, increases fullness, delays gastric emptying.	After 36 weeks A1C down to 5.7-6.5%
Tirzepatide	2022	Mounjaro	GLP-1-GIP	Blood sugar control and weight reduction	Activates GIP and GLP-1 receptors. Decreases food intake and modulates fat utilization. Stimulates insulin release. Increased adiponectin levels.	After 40 weeks A1C reduced by 2.24%
Cagrilintide	Not FDA Approved		GLP1-amylin	Blood sugar control and weight reduction	Targets calcitonin receptors and the GLP1R receptor. Controls fullness after eating and blood glucose control via insulin stimulation.	After 32 weeks A1C levels dropped by 2.8%

Table 2. Newer diabetes drugs, what they do, how they do it and their effectiveness.

The Importance of Treating Diabetes with Lifestyle & Pharmacological Interventions

While pharmacological interventions improve the well-being of those suffering from diabetes greatly, they need to be used in conjunction with lifestyle interventions to have the best outcome. Following a healthy diet, any of the ones mentioned above reduces the need for high doses of insulin to be taken. Similarly, exercise leads to weight reduction which will improve insulin sensitivity and can lead patients to reduce their medications. Additionally, medications tend to be more effective in individuals who live a healthy, active lifestyle. Similarly, exercise leads to weight reduction which will improve insulin sensitivity and can lead patients to reduce their medications. We know that hypertension is a very common comorbidity to diabetes,

exercise improves heart health and reduces the chances of major heart complications and diseases.

Treatment Pathways

Choosing a treatment method depends on the patient's symptoms and disease progression. According to Diabetes Canada (2018), the beginning of this decision starts with evaluating glycemic control, renal and cardiovascular status, weight change and dietary patterns. Next Individualized A1C targets will be determined. Then patients will be referred for diabetes education. Lastly, they will begin any healthy lifestyle interventions. If a patient's A1C target is attained by 3 months there are three options for further treatment (Lipscombe et al., 2020). Firstly, no pharmacotherapy and using lifestyle changes with the expectation that they will reduce blood glucose levels. Secondly, starting metformin in a patient A1C levels are more than 1.5% above their target. Thirdly, if patients have symptomatic hyperglycemia and/or metabolic decompensation they are to start insulin and metformin (Lipscombe et al., 2020). If a patient's A1C levels are not at target within three months, they will either be instructed to start metformin or adjust/advance therapy. Additionally, their A1C must be reassessed in 3-6 months (Lipscombe et al., 2020).

After being reassessed, if A1C is still not on target and/or there are any clinical status changes therapy must be advanced or adjusted. There are two pathways from here. If the patient has Atherosclerotic Cardiovascular Disease (ASCVD), Chronic Kidney Disease (CKD), Heart Failure (HF) or is greater than 60 years of age with 2 Cardiovascular Risk factors AHA must be added or substituted into their care plan. If a patient has ASVCD or CKD and a Major Adverse Cardiovascular Effect (MACE) they will be put on GLP1-RA or SGLTi (Lipscombe et al., 2020). If they have ASCVD, CKD ot HF and Hypertensive Heart Failure (HHF) they will be put on

SGLT2i. If there is Progression of Neuropathy and ASCVD or CKD patients will also be put on SGLT2i. If a patient has MACE and is older than 60 with CV risk factors they will be put on GLP1-RA (Lipscombe et al., 2020). If a patient has HHF and is older than 60 with CV risk factors they will be put on SGLT2i. If there is a Progression of Neuropathy and the patient is older than 60 with CV risk factors they will also be put on SGLT2i (Lipscombe et al., 2020).

The second pathway is if the patient's A1C is above target and they need to lower their glucose. Here treatment is decided based on whether there is a proven cardiorenal benefit in high-risk populations, if there is CV safety but no proven cardiorenal benefit or if there is a risk of HF (Lipscombe et al., 2020). Depending on this patients will either be put on GLP1-RAs or SGLT2is. Insulin may also be used in conjunction with these treatments (Lipscombe et al., 2020).

Conclusion

There are many different ways to go about treating type 2 diabetes. Physicians start with lifestyle interventions, focusing on healthy living. This might include aerobic exercise, interval or resistance training. Additonally, following diets similar to the mediterranean diet, a vegetarian diet or the DASH diet. Counselling and educaction on diabetes can also help patients to understand their illness. The next action by physicians is pharmacological interventions. This normally starts with metformin and insulin. Depending on the progression of disease and the patient GLP1-RAs and SGLT2is might be using also. As research progresses, newer drugs like triple-G agonists, semaglutides, danuglipron, retatrutide, tirzepatide and cagrilintide might be used. Diabetes Canada has a well laid out algorithm for disease treatment that physicians might following when determing the best line of treatment for their patients.

Understanding the underpinnings if Diabetes and the different ways to treat the disease is pertinent to understand the best practices used in Diabetes care. Similarly to the number of ways we can treat diabetes, care comes in different forms. In Canada, most health care professionals seem to follow the Critical Care Model. This method fails when put into practice at hospitals and clinics that are understaffed and underfunding. Meaning that the care patients are receiving is less than ideal. However, there are other ways to provide Diabetes care.

Diabetes Best Practices

Introduction

Best practices for the organization and delivery of diabetes care can occur in several different ways. Best practices are health practices, interventions, methods, techniques or procedures that are based on high-quality evidence to attain improved patient and health outcomes (Ham-Baloyi et al., 2020). This is normally dependent on the country, funding, staff size, patient demand and physician preference. Canada primarily follows the Critical Care Model (CCM) for diabetes care as their traditional mode of care. This is a way of treating chronic disease in a planned and proactive way that focuses on population-based care (Clement et al., 2018).

Unfortunately, overcrowding and underfunding make following the CCM difficult in some hospitals and clinics. When this occurs people tend to fall through the cracks and don't get the level of care they need or deserve. As a result, some alternatives to the CCM may be used to supplement this. Some of these include virtual care, community health workers, shared medical appointments and social prescribing. While these are alternatives, they are not replacements for care through the CCM. Everyone should be able to receive the best care possible but sometimes that is not possible.

The Critical Care Model

Diabetes Canada using the Chronic Care Model to optimize diabetes care delivery. This strategy aims to replace the current reactive approach to care for people with chronic diseases with a population-based, proactive one. According to preliminary studies, the treatment of patients with chronic diseases has been positively benefited by establishing team-based care,

boosting the skills of healthcare providers, especially in using registry-based information systems, and improving patient education and support (Baptista et al., 2016; EH Wagner et al., 1996; Renders et al., 2001). The CCM that is currently used in Canada has recently been expanded to include the following 6 components to improve health outcomes and strengthen the relationship between providers and their patients. These components include; delivery systems design, self-management support, decision support, clinical information systems, the community and health systems.

Firstly, delivery system design includes making systemic changes to health systems and primary care practice to improve the efficiency, quality and effectiveness of patient care (Clement et al., 2018). This might include case management, structured care, shared care, team changes, team-based care and continuous quality improvement. The next component is self-management support, which includes activities that aid the implementation and maintenance of behaviours for continuous diabetes self-management (Clement et al., 2018). Examples of this are self-management education and patient education. Decision support involves integrating evidence-based guidelines with the flow of clinical practice. This includes; audit and feedback, clinical education and benchmarking (Clement et al., 2018). Lastly, clinical information systems help to organize population and patient data that assists in efficient and effective care (Clement et al., 2018). For example, clinician reminders, patient registries, patient reminders, the facilitated relay of information to clinicians and electronic medical records (Clement et al., 2018).

Systematic research reveals that implementing the Chronic Care Model (CCM) in primary care practices is effective, with the integration of its components linked to enhanced care quality and improved outcomes for individuals with various chronic conditions, including diabetes (Coleman et al., 2010; Stellefson et al., 2013). A meta-analysis examining quality

improvement (QI) strategies in diabetes management highlights the significance of interventions addressing the chronic disease management system, coupled with patient-mediated QI strategies, in driving improvements in care (Tricco et al., 2012). While individual enhancements may be modest, employing various quality assurance (QA) components in a multidimensional approach can result in synergistic and complementary effects, as demonstrated in the referenced studies (Baptista et al., 2016; Busetto et al., 2016; Seidu et al., 2016).

Now that we have an understanding of what the CCM is and what it is composed of, how does this make it better for chronic disease management, specifically for diabetes? A unique aspect of the CCM is the focus on a team approach to care instead of a single specialist or primary care provider. Research has shown that this approach elicits better outcomes in terms of A1C, lipids, blood pressure and other care procedures (Clement et al., 2018). Moving away from the approach that the primary care provider/specialist provides all the care allows for collaborative care including nurse-led interventions and pharmacist participation. This allows new perspectives of care to be brought in and provides the patient with a well-rounded care regime (Clement et al., 2018). Having a team of healthcare professionals also allows for more resources to be available to the patient. There is a dietitian at hand or a psychiatrist- anything they could need is a lot more accessible. This type of expansive care also pushes patients to follow their care as they feel encouraged and supported (Clement et al., 2018). Additionally, focusing on the proactive benefits of the CCM, if we have a wide array of caregivers in one team already, there is no need for referrals or waiting for specialists. This will also cut down the amount of time that patients are waiting in hospitals and using resources that are already scarce.

While the CCM is the preferred method of care for treating those with diabetes, this does not mean it does not come with its limitations. In general, places that are implementing the CCM

are hospitals and clinics. Unfortunately, these places are more likely to experience overcrowding, underfunding and a general lack of sufficient resources. Many places that provide diabetes care prioritize their patients by disease severity and progression. This means those with more severe disease progression will be seen over those who are prediabetic or those with more manageable A1C levels. Additionally, persons who do not have the means to get to a hospital or clinic will suffer. The CCM struggles to be an accessible form of care for all.

Virtual care

This is where alternatives to the CCM come into play, ensuring that everyone can get care. Firstly, virtual care, which is when electronic information and telecommunication technologies are used to support long-distance clinical healthcare, professional and patient health-related education, public health and health administration (HRSA, 2022). Virtual care has recently become a popular means of treatment as a result of the COVID-19 pandemic. It can take place in several different ways including; video conferencing, the internet, streaming media, store-and-forward imaging and land and wireless communication (HRSA, 2022).

The use of virtual care for diabetes care is a relatively new concept and is still being studied. It is important to note that virtual care does not simply mean patient-provider appointments over the phone or video chat. Virtual care can take the form of text message reminders to patients or software that allows patients to upload their blood glucose levels to a hospital database (Faruque et al., 2017). It plays many aspects in its role as an alternative option for those who cannot access care in the form of the CCM. Virtual care improves the diabetic patient's self-management practices and clinical outcomes (Borries et al., 2019). Furthermore, the patient's ability to control their blood glucose levels and manage their illness improves (Anjana

et al., 2019). This means that patients are self-sufficient and ensure they are carrying out their care regime themselves but know they will always have someone there to help if needed.

Using virtual care in diabetes management comes with several benefits, namely; glycemic control, diabetes self-management, risk of hypoglycemia and cost-effectiveness. Firstly, looking at glycemic control, a randomized control trial using virtual care and 199 patients with diabetes mellitus was carried out. Even though there was not a significant difference in HbA1c between the control and teleconsultation groups, those who participated in virtual care were more satisfied with their care (Sood et al., 2017). Patients who are more satisfied with the care they are receiving are more likely to adhere to their care protocols and will, therefore, have better health outcomes. Additionally, when compared to conventional therapy, virtual care techniques showed considerable success in lowering HbA1c, according to a network meta-analysis that included 107 trials and 20,501 patients. The range of the mean difference (MD) was 0.37% to 0.71%. (Lee et al., 2017). This is a significant decrease in HbA1C levels and supports the idea that virtual care is a great alternative to CCM care.

Furthermore, patients receiving virtual care therapy showed a much greater decrease in HbA1c than patients getting conventional care, according to a meta-analysis by Tchero et al (2019). A randomized controlled trial showed that patients with type 2 diabetes mellitus had a higher HbA1c reduction than patients with type 1 diabetes mellitus. A meta-analysis measuring the effects of virtual care treatments on hypoglycemia episodes, HbA1c, and body mass index (BMI) in people with diabetes was conducted. The findings showed that, in comparison to standard treatment, virtual care improved HbA1c levels and decreased the risk of mild hypoglycemia, but had no discernible effect on BMI (Marker et al., 2020). Altogether, we can see that through meta-analyses and a randomized controlled study, virtual care treatment is very

effective in lowering HbA1c levels and lowering the risk of mild hypoglycemia in diabetic patients.

Next, patient and medical team communication about health can be effectively facilitated by virtual care. Together with patients, it cultivates cooperative relationships that promote evidence-based health treatments, individualized self-care routines, and positive lifestyle changes for the management of diabetes (Ju, 2020). Positive behaviour modification strategies for diabetic self-management seem to be linked to virtual care. Four clinical trials were combined into a meta-analysis, which showed how virtual care improved glycemic control and self-management in primary care settings in the short run (Chi F So et al., 2017).

The last benefit of virtual care is cost-effectiveness. Telemonitoring and phone reminders proved to be an affordable diabetes treatment strategy. In a cost-benefit analysis conducted on a retrospective cohort of 1000 patients with type 2 diabetes mellitus (T2DM), the Diabetes Tele Management System (DTMS) demonstrated efficacy and safety. After six months, there was a substantial 2.2% drop in the mean HbA1c. The additional cost of DTMS to patients, excluding the cost of insulin and oral medications, was $9.66 USD per month. As a result, DTMS seems to be an affordable method for treating T2DM aggressively without developing significant comorbidities.

From the above studies, there is an abundance of evidence that virtual care is beneficial in glycemic control in those with diabetes. It is also cost-effective and can help with the staffing issues and overcrowding that hospitals and clinics face. Virtual care means that fewer people will be coming into the clinic or hospital and staff numbers could be reduced as a result. Furthermore, this has the potential to help with underfunding that many healthcare settings suffer from. Altogether, virtual care is a great alternative to traditional care- the CCM- as it can reach more

people. It is not as restricted by time, travel and financial barriers and has a greater scope of accessibility (CDC, 2019).

Community Health Workers

The next alternative best practice that will be explored regarding diabetes care is the role of community health and community health workers (CHWs) in care. A community health worker is a member of the community who works as a volunteer or for a wage with a local health care system in rural and urban environments (NIH, 2014). Since community health workers (CHWs) typically live in the communities they serve, they can provide a unique and more personal perspective on situations. They may interact with people in places where they are comfortable and familiar with. CHWs are proven to improve access to healthcare, increase health screenings, increase the use of these services and improve adherence to health recommendations (HRSA, 2007).

Interventions by CHWs in diabetes care are a productive strategy- here it addresses individual and community-level factors. CHWs have been proven to improve knowledge about diabetes, self-care, self-monitoring and lifestyle changes when compared to participants' baseline characteristics (Shah et al., 2013). Educating persons on the disease they are struggling with is incredibly important for their ability to care for themselves properly. According to 44 cases, the most prevalent activity for CHWs was providing education services for Type 2 Diabetes (T2DM) self-management (Egbujie et al., 2018). Numerous studies have shown that these CHWs are often used as lay educators for T2DM patients. Even though the precise goals of education differed between research, improving patients' knowledge was the most often stated purpose

(Egbujie et al., 2018). In addition, CHWs offered instruction in problem-solving techniques, goal-setting, physical exercise, stress management, and medication adherence.

CHWs also play an important role in support for those with diabetes. This support might be in conjunction with education or on its own (Egbujie et al., 2018). Support given by CHWs can come in three main forms; appraisal support, instrumental support and emotional support. Supporting patients in conducting their self-management assessments (knowledge and behaviour) based on previously given instruction was referred to as appraisal support (Egbujie et al., 2018). The majority of instrumental support was assisting patients in "navigating" the healthcare system and other systems—like social services, financial aid, and referrals—that promote the maintenance of a healthy lifestyle (Egbujie et al., 2018). Diabetes sufferers also receive vital emotional assistance from CHWs. Support services were usually combined and customized to meet the needs of each individual (Egbujie et al., 2018).

CHWs help patients practice and use advocacy when going through their care regime. In this area, advocacy refers to CHWs' assistance in helping patients speak with their doctors and healthcare institutions so that they may receive high-quality clinical treatments that comply with established criteria (Egbujie et al., 2018). This entails helping patients receive necessary medical supplies such as insulin, prescription drugs, and orthopedic shoes, since acquiring these items might take longer without help. When compared to alternative combinations of responsibilities, the most often reported approach—a combination of education and support activities—is more likely to result in improvements in HbA1c and diabetes knowledge (Egbujie et al., 2018).

CHWs provide a more accessible way for those who live in rural or underserved areas to receive care. They have a more personal relationship with the patient and their culture. These people are at an even greater potential for not being able to access the traditional CCM for

diabetes care. The care received from CHWs is more in the form of support and education. However, this plays a significant role in patient outcomes. Much of the time, patients do not adhere to their care protocols as they do not understand why or how they are following them. This results in poor health outcomes, in the case of diabetes, and poor A1C levels.

Shared Medical Appointments

Another way that patients with diabetes can receive care if they cannot access the CCM is through shared medical appointments (SMAs). These have gained popularity recently and work to enhance illness outcomes in addition to pharmaceutical management by using educational and self-management techniques. In SMAs, several patients get a wide array of treatments in the same clinical environment for a common chronic illness (Edelman, 2015). SMAs often involve many healthcare providers; typically, the care team consists of a prescribing practitioner with the authority to create and implement a complete care plan, as well as a person competent in patient education or interaction facilitation (Noffsinger, 2002). To create cohesion within the patient group, the group may remain unchanged, or patients may be permitted to attend sessions at their leisure by selecting them from a schedule. Similar to this, healthcare professionals may change over time or remain consistent with the same patients (Park, 2013).

For patients with chronic illnesses, the group medical visit format is helpful since it allows doctors to see 12–15 people in one visit and encourages communication among patients who have comparable ailments (Housden et al., 2013). The use of group medical visits to provide primary healthcare to people with diabetes is increasing in Canada, where the combined prevalence of type 1 and type 2 diabetes is around 6.8% of the population. Research suggests that

receiving social support from peers who also have diabetes can have a favourable impact on specific clinical outcomes (Housden et al., 2013).

Several well-known press publications in recent years have demonstrated the growing interest in and use of SMAs (Gorman, 2013). Studies showed that after 6 months A1C levels were lower than in those who received normal care (Edelman, 2015). For example, in a study done by Sadur et al. (1999), the result of 2-hour SMAs with a nurse educator, dietitian, pharmacist and behaviour therapist saw a significant reduction in A1C levels when compared to a group that was traditionally treated. The test group also resulted in fewer hospital admissions and better self-treatment methods. Another study done by Gold et al. (2008) looked at two groups, one with synchronous provider visits and education sessions and a control group. The test groups saw statistically significant improvements in A1C when compared to the control group.

Aside from direct effects on A1C, SMAs are a great way to educate groups of people on diabetes and the best way to care for their disease. This is easier on the physician as they can see more patients in a shorter amount of time. As well as being a more interactive way for patients to learn about diabetes. Patient education has direct effects on improving health outcomes. In a study by Hernandez et al. (2016), participants of SMA programs stated that being educated about the appropriate diets and right exercises for treatment helped in their disease management. Patients also stated that SMAs gave them a sense of accountability. The fact that every 3 months they had to come in to test their A1C levels and that others would be there doing the same, made them feel more obliged to come back in (Hernandez et al., 2016).

As an alternative to the CCM of diabetes treatment, SMAs provide a well-rounded way to treat diabetes. The above studies show that SMAs are more effective than standard therapy, with

reduced A1C readings and better self-treatment techniques. SMAs provide a supportive atmosphere for patient education that goes beyond A1C results, promoting physician efficiency and participatory learning. Participants highlight the beneficial effects on health outcomes of SMA programmes, stating that they feel more responsible and prepared to manage their condition. While it is clear that SMAs have several benefits for the patients they are also beneficial to providers, clinics and hospitals. The ability to see multiple patients at once helps to reduce overcrowding faced by hospitals as a larger group of people can be assisted at once. Additionally, it helps to cut down costs as more people are being seen in a period compared to over several days- meaning less costs to the hospital when paying hourly wages.

Social Prescribing

All the alternatives that were mentioned above are used as direct alternatives for traditional diabetes care. However, this is not the only method that can be used, lifestyle changes play a pertinent role in care of any kind. This is where social prescribing comes into play. It can be described as a comprehensive method of treating patients that integrates the social and medical concepts of health and wellbeing (Alliance for Healthier Communities). It gives medical professionals a structured approach to addressing the various factors that influence health while utilizing the dependable and comfortable prescription writing procedure. By directing patients to nearby, non-clinical services that are selected based on the client's interests, objectives, and gifts, social prescribing fills the gap between clinical and social care (Alliance for Healthier Communities). Through community-based programmes, it enables medical professionals, nurse practitioners, and other interdisciplinary health providers to formally refer patients. It gives clients the tools they need to take charge of their health by learning new skills, engaging in

fulfilling activities, and strengthening their relationships with the community (Alliance for Healthier Communities).

Social prescribing can add another layer to the care given in alternative methods to the CCM- CHWS, SMAs and virtual care. As mentioned above, these forms focus on the pharmacological ways of treating diabetes. Social prescribing adds the layer of lifestyle changes that have such a big impact on care and treatment. For example, looking at virtual care, integrating social prescribing into online platforms for virtual care so that medical professionals may easily recommend and link patients to community services (Alliance for Healthier Communities). SMAs can be used to promote peer support by giving patients a forum to talk about and exchange their experiences with social prescribing, which strengthens the group's sense of community (Oster et al., 2023). Lastly, CHWs can enhance the efficacy of prescribed therapies by educating patients about social prescribing choices, helping with programme enrollment, and offering continuing support (Alliance for Healthier Communities).

Conclusion

Again, none of these forms of alternative care are meant to replace the CCM for diabetes treatment. Unfortunately, not everyone is able and capable of accessing this level of care but it is a sad reality in today's day and age. Hospitals and clinics are overcrowded and chronically underfunded. This lack of resources is not the patients doing but they are the ones that suffer. The alternative forms of care mentioned above are the best option for optimizing care for patients and providers. They create an accessible environment for everyone to attain care, regardless of geographical location, accessibility needs or funding needs. They help providers maximize the care they can give with the limited resources they possess.

In conclusion, achieving best practices in diabetes care involves implementing evidence-based health practices, interventions, methods, techniques, or procedures. The choice of approach often depends on factors such as country, funding, staff size, patient demand, and physician preference. Canada predominantly adheres to the Critical Care Model (CCM) for diabetes care, emphasizing planned and proactive treatment on a population-based level. However, challenges like overcrowding and underfunding in some healthcare settings hinder the effective implementation of the CCM, leading to gaps in patient care. In response to these challenges, alternative approaches such as virtual care, community health workers, shared medical appointments and social prescribing may be employed, although they are not substitutes for the comprehensive care provided by the CCM. Despite the desire for everyone to receive optimal care, external factors sometimes limit the attainment of this goal, highlighting the ongoing need for addressing systemic challenges in diabetes care delivery.

Being educated on alternative best practices to the Critial Care Model allowed me to curate a set of questions that I used to guage the PRHC Diabetes Clinic's staffs thoughts on the clinic. I used these questions and answers, along with my research to provide a set of recommendations to the Clinic regarding their Diabetes Best Practices

Best Practice Recommendations for the PRHC Diabetes Clinic

Introduction

Peterborough Regional Health Center has a clinic dedicated to Diabetes diagnosis, care and education. The clinic provides services to adults with Type 1, Type 2, or other types of diabetes, as well as women managing gestational diabetes, whether they are newly diagnosed or looking to learn more about the illness. For specialized care, patients with diabetes under the age of 18 are sent to the Paediatric Diabetes Education Centre at PRHC. They provide full-service diabetes self-management instruction, which includes virtual group education classes and private sessions with our multidisciplinary team over the phone, in person, or online. The clinic also help patients navigate the provincial Assistive Devices Programme (ADP), which is very helpful for patients who use insulin pumps. Their diabetes self-management education programme covers blood glucose monitoring, insulin administration, medication management, diet, and mental health assistance.

PRHC Staff Questionnaire Responses

I curated several questions to ask the staff at the clinic to gauge how they thought the clinic was going and any recommendations they had. The goal of this was to use the information gathered in conjunction with my research on diabetes best practices to create several recommendations to make to the clinic. I will summarize the questions and answers in the paragraphs to follow and make my final recommendations in this paper.

The first question focused on the clinic's operational strengths, emphasizing features that the staff members who were questioned thought were beneficial. The team was in agreement on the clinic's excellent performance in several crucial areas. The clinic has received praise for its strong information distribution techniques, collaborative atmosphere, and outstanding team

synergy. A lot of knowledge and a strong sense of community are present in this setting, which fosters a friendly environment that is ideal for providing high-quality patient care. A focus on upholding a nonjudgmental environment is emphasized, supported by a thorough knowledge of diabetes and a dedication to staying current with scientific and technical developments.

The team's multidisciplinary makeup makes it easier to appropriately triage patients and refer them to specialists when needed. Notably, the clinic accepts appointments as well as last-minute requests for assistance and offers prompt phone or email support. The development of a culture based on trust and ongoing learning, encouraging group progress and rejecting a blame culture, is fundamental to its ethos. Moreover, the clinic exhibits competence in managing ailments that smaller healthcare institutions generally neglect, such as pregnancy-related issues, Type 1 diabetes treatment, and insulin pump administration.

Several proposals surfaced in answer to the question about tactics to improve patient care and clinic operations. Important recommendations include resuming treatment for those who have just received a diagnosis and attending to privacy issues. To accommodate the increasing number of patients, it is necessary to increase personnel by one two or three team members. It's also a good idea to look into the possibilities of expanding operating hours and improving scheduling procedures. Employees want more time to be spent adopting novel treatment strategies and getting input from patients.

Getting more money to increase manpower is thought to be crucial for handling the growing patient volume. It is recommended that patients be given more proactive control over their health management in order to minimize the need for frequent clinic visits. Furthermore, in order to facilitate the shift to preventative healthcare activities, it is important to recognize the significance of a place specifically designated for private patient contacts.

In answer to the question concerning possible modifications or discontinuations of current procedures, staff members tended to be unable to identify particular alterations. On the need to improve the present processes, there is agreement. The focus is on promoting improved teamwork among medical professionals, with a specific focus on promoting combined consultations instead of separate sessions between dieticians and nurses. To encourage patient autonomy and increase clinic efficiency, efforts are being made to optimize the processes involved in rescheduling appointments. Additionally, inefficiencies resulting from patient cancellations or no-shows are being taken into account. The possibility of obtaining a new facility site is brought up, implying possible changes to the physical design of the clinic.

After that, employees were asked what they thought was the clinic's most urgent problem, and they had a wide variety of answers. The clinic faces several important obstacles, the most important of which are privacy issues resulting from its present location. Together with a lack of funding and a personnel shortfall, these problems are the main challenges. The problem is made worse by the lack of primary care doctors, which leads to an increase in patients with more serious conditions, further taxing the clinic's resources. The community's lack of family physicians adds to the burden on healthcare resources.

These difficulties are made worse by a lack of funds, scarce resources, and the confines of a small, open clinic area. In addition, the growing patient load, which is made worse by the retirement of neighbourhood family physicians, exacerbates the problem. The clinic's inability to supply the increasing number of patients seeking care is a result of the ten-year trend of stagnating budget allocations and difficulty finding replacements.

Recommendations to Peterborough Regional Health Centers Diabetes Clinic

From my literature reviews and interviews conducted with the PRHC Diabetes Clinic, I have created several recommendations that I put forward. It is important to note that these recommendations are only possible with sufficient funding and staffing.

1. **Telehealth and virtual appointments**

   Through my interviews with the clinic staff, one of the biggest issues was an abundance of patients and not enough staff to deal with all inquiries and questions. Creating a team made up of two to three staff members who are dedicated solely to answering phone calls and taking virtual appointments, this stress can be alleviated. Staff stated that they often have many calls that they do not have the time to take during the day. These calls are generally smaller inquiries about equipment minor health concerns- ones that do not need appointments but need to be addressed. If there is a group of staff members who answer these questions and concerns throughout the day, the other staff members can focus on their in-person appointments. Studies back this up by showing that there is an abundance of data supporting the benefits of virtual treatment for diabetes patients' glucose control. In addition, it is economical and helps alleviate the congestion and staffing problems that hospitals and clinics encounter. Because of virtual treatment, fewer patients will visit the clinic or hospital, which may lead to a reduction in personnel. Moreover, this may alleviate the underfunding that many healthcare facilities experience.

2. **Group Appointments**

   My second recommendation would be to bring back the facilitation of group appointments. The clinic staff had mentioned that this was something they did before COVID-19, however, it had not been brought back into practice. Group appointments are

great for educational purposes. They can address many people at once and it does not diminish the effectiveness of the appointment. While it cannot be used for more sensitive or private information, it can be used to address minor health concerns, similar to virtual appointments. Educating individuals thoroughly on diabetes diagnosis, care and management means that they understand their disease to a great extent. This will hopefully alleviate phone calls or appointments made more minor health concerns. It has also been shown that these types of group appointments are being used more than one-on-one appointments as it is more effective (Housden et al., 2013).

3. **Collaboration with Community Health Centers**

My last recommendation involves collaboration with Community Health Centers. Up until 2 months ago, Peterborough did not have a Community Health Center, this has now changed. The province has announced that a Community Health Center that will employ up to 60 staff will be built in the City. This collaboration will alleviate the stress that the PRHC Diabetes Clinic experiences on a day-to-day basis exponentially. The absence of family doctors in Peterborough leaves most if not all of Diabetes care and diagnosis to the PRHC Clinic. However, they have too many patients and are currently only seeing higher-priority persons. This means that there is a large number of individuals in the city who are not receiving the care they need. Collaboration with a Community Health Center means that initial diagnosis and treatment for lower-priority patients could be done here. Additionally, it is the perfect place for group education sessions. The PRHC Diabetes Clinic could then focus on their higher-priority patients.

Conclusion

To conclude, the recommendations made include the use of virtual visits and telehealth services to reduce staff effort and enhance patient access. Group consultations, have to be brought back in order to effectively handle minor medical issues. Collaboration with the recently founded Community Health Centre also has the potential to alleviate some of the clinic's workload by providing lower-priority patients with initial diagnosis and treatment as well as group education sessions. However, it's important to recognise that these suggestions depend on having enough money and employees. By putting these techniques into practice, the PRHC Diabetes Clinic will be able to improve patient care, reduce operational difficulties, and carry on its tradition of excellence in diabetes management in the community.

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Appendix

RN

What do you think the clinic is doing well?

- Good team work
- Collaborative
- Good at sharing knowledge amongst team members

What do you think will help the clinic operate to its full potential and help the most patients?

- Privacy is a big issue
- Wish that they could open back up help to those newly diagnosed

Is there anything you think needs to go or be changed that is already in place?

- No answer

Do you think support for you as a staff member (monthly meetings with a therapist/mediator) would help to alleviate stress caused by the job?

- Private help to staff would be helpful but doesn't feel like management would care

What is the biggest challenge the clinic is facing?

- Lack of privacy

Do you think a focus on telehealth/virtual appointments would help? Having a team dedicated to this?

- Already do this

Do you think that putting an emphasis on trying to connect with the community healthcare centers will be helpful? How so?

- Education days were really helpful

What are your thoughts on group appointments?

- Group appointments very important
- Made ppl feel supported and like they weren't the only ones going through it

Dietitian

What do you think the clinic is doing well?

- Collaborative, team dynamic, more experienced staff members are willing to help out
- Stay on top of new research and technology

What do you think will help the clinic operate to its full potential and help the most patients?

- More staff
- Limitations to certain things
    - Is it worth trying to be open other times of the day
- Changing scheduling
- More feedback from patients
- More dedicated time to work on those ideas to improve care

Is there anything you think needs to go or be changed that is already in place?

- No answer

Do you think support for you as a staff member (monthly meetings with a therapist/mediator) would help to alleviate stress caused by the job?

What is the biggest challenge the clinic is facing?

- Understaffed and lack of funding
- A lot of patients no longer have primary care providers
- Results in more pressure on the clinic

Do you think a focus on telehealth/virtual appointments would help? Having a team dedicated to this?

- Focusing on virtual appointments would not be helpful need to rotate people through this, educators need to see people face to face
- Some people would benefit from this but others better in person

Do you think that putting an emphasis on trying to connect with the community healthcare centers will be helpful? How so?

- Not sure how collab w community health would be good
- Worth communicating

What are your thoughts on group appointments?

- Place for group appointments
    - Depends on person
    - Helping with lower priority

- Where collab w family health team

Nurse Practitioner

- Been at clinic for 3 years
- Been a NP for 10 years

What do you think the clinic is doing well?

- Warm and inviting environment
- Staff know a lot about diabetes

What do you think will help the clinic operate to its full potential and help the most patients?

- More privacy

Is there anything you think needs to go or be changed that is already in place?

- No answer

Do you think support for you as a staff member (monthly meetings with a therapist/mediator) would help to alleviate stress caused by the job?

- No

What is the biggest challenge the clinic is facing?

- Lack of family doctors, therefore, heavy patient load
- Patients coming in with a worse disease level than usual because cant see family doctor

Do you think a focus on telehealth/virtual appointments would help? Having a team dedicated to this?

- Yes, staff is overwhelmed already with calls about smaller health issues- would help this

Do you think that putting an emphasis on trying to connect with the community healthcare centers will be helpful? How so?

- Yes in the sense of collaborating and letting community clinics know more about the prhc clinic and what they do and how patients can be referred here

What are your thoughts on group appointments?

- Good for early diabetes and new diagnosis

RN

- At clinic for 6 months
- Been an RN for 13 years

What do you think the clinic is doing well?

- Good at working as a team
- Advocating for clients
- Non judgemental atmosphere

What do you think will help the clinic operate to its full potential and help the most patients?

- Staffing
- Two to three extra staff members would be very helpful

Is there anything you think needs to go or be changed that is already in place?

- More team based work
- Having a dietitian and nurse work together with a patient rather than them seeing each separately

Do you think support for you as a staff member (monthly meetings with a therapist/mediator) would help to alleviate stress caused by the job?

What is the biggest challenge the clinic is facing?

- Lack of funding
- Lack of resources
- New clinic space is terrible- no privacy

Do you think a focus on telehealth/virtual appointments would help? Having a team dedicated to this?

- Good for those who are older or have mobility issues
- some ppl who opt for phone appointments but should be seen in person

Do you think that putting an emphasis on trying to connect with the community healthcare centers will be helpful? How so?

- Would be especially good for those who the clinic cannot see

What are your thoughts on group appointments?

- More education based

Appendix

Linda- RN

What do you think the clinic is doing well?

- Good team work
- Collaborative
- Good at sharing knowledge amongst team members

What do you think will help the clinic operate to its full potential and help the most patients?

- Privacy is a big issue
- Wish that they could open back up help to those newly diagnosed

Is there anything you think needs to go or be changed that is already in place?

- No answer

Do you think support for you as a staff member (monthly meetings with a therapist/mediator) would help to alleviate stress caused by the job?

- Private help to staff would be helpful but doesn't feel like management would care

What is the biggest challenge the clinic is facing?

- Lack of privacy

Do you think a focus on telehealth/virtual appointments would help? Having a team dedicated to this?

- Already do this

Do you think that putting an emphasis on trying to connect with the community healthcare centers will be helpful? How so?

- Education days were really helpful

What are your thoughts on group appointments?

- Group appointments very important
- Made ppl feel supported and like they weren't the only ones going through it

Alexandra- Dietitian

What do you think the clinic is doing well?

- Collaborative, team dynamic, more experienced staff members are willing to help out
- Stay on top of new research and technology

What do you think will help the clinic operate to its full potential and help the most patients?

- More staff
- Limitations to certain things
    - Is it worth trying to be open other times of the day
- Changing scheduling
- More feedback from patients
- More dedicated time to work on those ideas to improve care

Is there anything you think needs to go or be changed that is already in place?

- No answer

Do you think support for you as a staff member (monthly meetings with a therapist/mediator) would help to alleviate stress caused by the job?

What is the biggest challenge the clinic is facing?

- Understaffed and lack of funding
- A lot of patients no longer have primary care providers
- Results in more pressure on the clinic

Do you think a focus on telehealth/virtual appointments would help? Having a team dedicated to this?

- Focusing on virtual appointments would not be helpful need to rotate people through this, educators need to see people face to face
- Some people would benefit from this but others better in person

Do you think that putting an emphasis on trying to connect with the community healthcare centers will be helpful? How so?

- Not sure how collab w community health would be good
- Worth communicating

What are your thoughts on group appointments?

- Place for group appointments
    - Depends on person
    - Helping with lower priority

- Where collab w family health team

Graham (NP)

- Been at clinic for 3 years
- Been a NP for 10 years

What do you think the clinic is doing well?

- Warm and inviting environment
- Staff know a lot about diabetes

What do you think will help the clinic operate to its full potential and help the most patients?

- More privacy

Is there anything you think needs to go or be changed that is already in place?

- No answer

Do you think support for you as a staff member (monthly meetings with a therapist/mediator) would help to alleviate stress caused by the job?

- No

What is the biggest challenge the clinic is facing?

- Lack of family doctors, therefore, heavy patient load
- Patients coming in with a worse disease level than usual because cant see family doctor

Do you think a focus on telehealth/virtual appointments would help? Having a team dedicated to this?

- Yes, staff is overwhelmed already with calls about smaller health issues- would help this

Do you think that putting an emphasis on trying to connect with the community healthcare centers will be helpful? How so?

- Yes in the sense of collaborating and letting community clinics know more about the prhc clinic and what they do and how patients can be referred here

What are your thoughts on group appointments?

- Good for early diabetes and new diagnosis

Tiffany (RN)

- At clinic for 6 months
- Been an RN for 13 years

What do you think the clinic is doing well?

- Good at working as a team
- Advocating for clients
- Non judgemental atmosphere

What do you think will help the clinic operate to its full potential and help the most patients?

- Staffing
- Two to three extra staff members would be very helpful

Is there anything you think needs to go or be changed that is already in place?

- More team based work
- Having a dietitian and nurse work together with a patient rather than them seeing each separately

Do you think support for you as a staff member (monthly meetings with a therapist/mediator) would help to alleviate stress caused by the job?

What is the biggest challenge the clinic is facing?

- Lack of funding
- Lack of resources
- New clinic space is terrible- no privacy

Do you think a focus on telehealth/virtual appointments would help? Having a team dedicated to this?

- Good for those who are older or have mobility issues
- some ppl who opt for phone appointments but should be seen in person

Do you think that putting an emphasis on trying to connect with the community healthcare centers will be helpful? How so?

- Would be especially good for those who the clinic cannot see

What are your thoughts on group appointments?

- More education based

Dietician

1. **What do you think the clinic is doing well?**

We have an amazing team with lots of collective knowledge and experience. We have a no blame approach and learn from each other and have created a culture of learning from each other in a safe environment so we can all do our best. The most important thing we have is trust in each other, I would say.
We do a great job of managing pumps and Type 1 DM and pregnancy, this is a specialty area that is not often managed well (or not at all) in other smaller sites.

2. **What do you think will help the clinic operate to its full potential and help the most patients?**

More support from the hospital and adequate funding. We haven't been increased in funding since 2006 despite diabetes prevalence going up annually in Canada, especially since the pandemic. We also need to do outreach (teach other providers, go to homeless shelters, offer cooking workshops in the community, address food insecurity in the community, do advocacy work) and be supported by the hospital to do outreach and be in the community more. We are being told we have to see only the very sick and we don't have time or capacity to do preventative health care anymore. We need to move to a space that allows for private patient encounters.

3. **Is there anything you think needs to go or be changed that is already in place?**

Our new location

4. **What is the biggest challenge the clinic is facing?**

Acute care mindset. We are an outpatient clinic. Our funding is not being used as it was meant to be used.

5. **Do you think a focus on telehealth/virtual appointments would help? Having a team dedicated to this?**

We already do this.

6. **Do you think that putting an emphasis on trying to connect with the community healthcare centers will be helpful? How so?**

A question for your question-
What do you mean "community healthcare centers?" there are different forms of primary care. I recommend researching the difference between CHCs and FHTs in Ontario if you aren't already familiar.
We don't have a local community health center. There is one that was just funded (announced this week) but not built yet. We do have a family health team in Peterborough, which is made up of many community Family Health Organizations. Some

of those have diabetes teams (our pharmacist works on one of those teams). Of course not working in silos is always ideal. However our systems are set up to not allow for this. We don't have the time or support to focus on quality improvement. We are just trying to keep our head's above water. Welcome to healthcare in 2024 in Ontario.

7. **What are your thoughts on group appointments?**
   We do this for pumps but can't now because of lack of space.

Laura- Manager

What do you think the clinic is doing well?

- We have a team of very strong clinicians, who have extensive knowledge in managing diabetes. They are truly experts in the care they provide.
- The team cares deeply about their patients, and will always do what is in the best interests of our patients and to try to make their diabetes care as simple as possible for them.
- We have a mix of health care professionals (RN, RD, SW, PH, NP) and the team is great at identifying when a patient may require the support of another discipline, and referring them appropriately.
- We support patients with both scheduled appointments, and also support as issues arise. They can contact us by phone or email and get timely support to manage acute issues with their diabetes.

1. **What do you think will help the clinic operate to its full potential and help the most patients?**

- In a perfect world, the answer to this question would be more funding for more staffing resources. We have more patient volumes than we can support with our current staffing.
- In a realistic world, we're working on ensuring that we are educating patients to manage their own diabetes, rather than managing it for them. Encouraging and empowering patients to care for themselves is not only best for patients, but reduces the frequency with which they need to visit the clinic, so we can see more patients.

2. **Is there anything you think needs to go or be changed that is already in place?.**

- We are working on changing our rebooking practices, so patients appointments are spaced farther apart. This aligns with my comments above, that we want to encourage patients to be more independent in their care, and have the knowledge to care for their diabetes on their own. As well, it will open up more appointments for the clinic.
- We also need to (and are in the process of) addressing our policy for patients who cancel or no-show. Currently, these patients are rebooked ASAP. However, that is taking up appointments from other patients who want to attend the clinic. We will be moving to letting our patients know that when they cancel or no-show, they will be rebooked 1-3 months out. We hope to reduce the amount of no-shows and cancellations, so that clinicians time isnt wasted on appt slots with no patients, while others wait for appointments.

3. **What is the biggest challenge the clinic is facing?**

- Increasing volumes of patients. You may know, Peterborough has had a large number of family doctors retire recently, with many more expecting to retire over the next couple of years. We have not been able to recruit and back-fill those family physician positions, leaving many patients without primary care. When this happens, patients with diabetes

have no where else to go, and physicians often send us massive amounts of referrals, for every patient they care for with diabetes.
- Funding, and therefore staffing levels, have not increased in over 10 years. As patient volumes increase but staffing does not, the challenge to see all patients who could use our services becomes more and more difficult.

4. **Do you think a focus on telehealth/virtual appointments would help? Having a team dedicated to this?**
- We do currently offer these appointments to patients. For many patients, this is a great option. We can view data from blood sugar monitors & insulin pumps online remotely, and speak to the patient over phone/video conference and provide great care
- One big barrier to this right now is patient preference – many patients simply prefer to come in person.
- We don't find that visits are any faster using telehealth, so it doesn't really help us address our volumes any better. However, it is a patient centered option for those who prefer not to drive into the hospital.
- Telehealth & telephone has also been beneficial given our physical space constraints, as we have clinicians work from home to conduct these appointments, freeing up more physical space in the clinic.

5. **What do you think about group appointments? Do you think that this is feasible?**

    - These are feasible and were used in the past. The biggest barriers so far to re-launching group appointments are 1) physical space to run the groups and 2) time involved to plan the groups.
    - As you've seen our new clinic space, you can likely tell there arent any rooms big enough in there to have group appointments. PRHC as a whole is tight on space, and big rooms to accommodate groups are hard to come by.
    - Planning for groups not only includes time to plan the content, but clinicians also need to be involved in triaging what patients are suitable for a group setting (i.e., those with cognitive impairment may not be appropriate to learn in this manner). As well, advice/guidance on diabetes can range so much from one patient to the next, making it difficult to form a group where general education can be given. Often it turns into each patient needing individual follow up to go over their specific needs, which doesn't save the clinic any time.
    - I think the team would be very open to running group sessions if we had a successful "blue print" to follow for which patients to include, how to teach to a group, what content to cover, etc. If other areas are doing this well, we would like to learn from them.

6. **Is there any other specialties/ staff other than NPs, RNs, DTs, SWs that you think would be beneficial to the staff?**

- Again this comes back to funding, so realistically, I don't foresee us adding any additional disciplines in the near future
- In a perfect world, having a chiropodist to do foot assessments and provide footcare in the clinic would be a very patient centered way to provide this care. Currently, we refer out to chiropodists in the clinic.
- RPNs are another discipline that we would look to add to the clinic in the future, with a very similar scope to that of the RNs in the clinic.
- Increasing the amount of staff we have would be most beneficial, for all disciplines we could definitely utilize more staffing.