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Physicians' Perceptions of the Utility of Clinical Guidelines in the Management of People with Type 2 Diabetes in Saudi Arabia

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Approval of the Dissertation Committee

This dissertation has been duly read, reviewed, and critiqued by the Committee listed below, which hereby approves the manuscript of Abdulaziz Eskandarani as fulfilling the scope and quality requirements for meriting the degree of Doctor of Public Health.

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ABSTRACT

Physician Perceptions of the Utility of Clinical Guidelines in the Management of People with Type 2 Diabetes in Saudi Arabia

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Aim: The aim of this research was to assess physicians' perception of the utility of clinical guidelines in the management of people with Type 2 diabetes in Saudi Arabia and how their perception is affected by different physicians' characteristics and whether high perception would result in adherence to guidelines.

Methods: This study employed a cross-sectional study design and used a self-administered online survey through Qualtrics software. The survey was distributed through the Saudi Society for Diabetes (SSD) whose membership includes more than five-thousand active physicians from all regions of Saudi Arabia. There were 493 respondents to the survey.

Results: Around half of the study participants (52.5%) were female, (50.9%) were aged 45 years and below, (55.8%) were non-Saudis, (52.1%) of study participants were board-certified, (30.5%) had more than 15 years of experience after getting the medical degree, (45.9%) had more than 15 years of experience in their specialization, and (27.6%) were from the Northern region. The key findings of this research are: 1) physicians' perceptions about the utility of clinical guidelines significantly differed based on years of experience after obtaining their degree, the region of practice, utilization of clinical guidelines to manage their patients, and the types of clinical guidelines used to manage Type 2 diabetes patients; 2) having five to ten years of experience in

practicing specialty negatively affect physicians' perception towards the utility of clinical guidelines; 3) physicians who are aged over 55 years and those who reported having years of experience in specialty over 5 years were more likely to use clinical guidelines to manage Type 2 diabetes patients ($p \leq 0.01$); and 4) physicians' perception showed a negative mediation effect for the age group 36-45 years and those who reported duration of experience of 11-15 years after obtaining their degree on their utilization of clinical guidelines to manage Type 2 diabetes patients. At the same time, physicians' perception showed a positive mediation effect for those who reported a duration of experience in the specialty of 15 years and above.

Conclusion: In general, physicians' perception of the utility of diabetes guidelines is positive. Nevertheless, other parts of the healthcare system should be investigated and improved to acquire new changes required for achieving optimum care.

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Chapter 1: Introduction

1.1. Background

Diabetes mellitus (DM) is a condition characterized by an elevated blood glucose concentration, also known as hyperglycemia (Sone 2018; Mayo Clinic Staff, 2020; Sperling, Wolfsdorf et al., 2021). Diabetes mellitus is defined as a disturbed energy metabolism syndrome, which alters fat, protein, and carbohydrate levels resulting from disorders in insulin function and\or insulin secretion (American Diabetes Association, 2014; Sperling, Wolfsdorf et al., 2021). Deficiencies in insulin function and impairment of insulin secretion often cohabit in the same patient, and it is sometimes difficult to distinguish the difference between insulin deficiency and impairment of insulin secretion, thus it is generally unknown or undetectable to pinpoint the primary reason for hyperglycemia (American Diabetes Association, 2014).

The signs and symptoms of DM vary depending on the degree of hyperglycemia (Mayo Clinic Staff, 2020). The classical DM signs and symptoms involve unexplained weight loss, polyuria, polyphagia, and polydipsia (American Diabetes Association, 2014; Mayo Clinic Staff, 2020). Diabetes mellitus signs and symptoms also include fatigue, slow-healing sores, irritability, and blurred vision. In some cases, chronic hyperglycemia could also be associated with exposure to certain infections (like skin, vaginal, or/and gum infections) and growth impairment (American Diabetes Association, 2014; Mayo Clinic Staff, 2020). The most intense clinical manifestations for DM are non-ketotic hyperosmolar syndrome or ketoacidosis, which are outcomes from uncontrolled DM, which is an acute life-threatening health status that may cause dehydration, coma, and mortality in the lack of efficient therapy (American Diabetes Association, 2014).

Long-term uncontrolled DM is linked with systemic complications including (a) macroangiopathy or macrovascular complications (cardiovascular diseases (CVDs) [peripheral

artery disease (PAD), stroke, and coronary heart disease (CHD)]), and (b) microvascular complications (neuropathy, nephropathy, and retinopathy) (Carver and Abrahamson, 2009; Abutaleb, 2016; Sone, 2018). Those complications result in a reduction in both the quality and longevity of life. Moreover, DM patients are at an increased risk of other comorbidities including cataracts, abnormalities of lipoprotein metabolism, nonalcoholic fatty liver disease, obesity, heart failure, erectile dysfunction, hypertension, and some infectious diseases such as tuberculosis (World Health Organization, 2019).

This introduction focuses on the etiologic classification and diagnosis of DM, as well as risk factors, epidemiology, and management of DM.

1.2. Etiologic Classification of Diabetes Mellitus

The conditions that existed at the time of the individual's DM diagnosis are usually used to define the kind of DM the individual has (American Diabetes Association, 2014). However, numerous people with DM do not readily fit into one category. For instance, despite the fact that thiazides rarely raise blood sugar, long-term use may develop into DM. also, for individuals who have already been diagnosed with type 2 DM or who were not yet diagnosed, thiazides can worsen their condition. Similarly, a person who takes large doses of exogenous steroids (glucocorticoids) may develop DM because of them, but as soon as he/she stops taking glucocorticoids, blood sugar returns to the normal level, later the same person may experience repeated attacks of pancreatitis for many years, resulting in the development of DM. Another instance is that an individual diagnosed with gestational diabetes mellitus (GDM) may have persistent high blood sugar after birth and may be specified to have type 2 DM. Incidentally, for the patient and physician,

understanding the reason for hyperglycemia and efficiently treating it is more crucial than categorizing a specific type of DM (American Diabetes Association, 2014).

According to the American Diabetes Association (ADA), the etiological classifications of DM are discussed in the next section (American Diabetes Association, 2014).

1.2.1. Type 1 Diabetes Mellitus

A. Immune-Mediated Type 1 Diabetes Mellitus

Immune-mediated type 1 DM, also known as juvenile-onset diabetes or insulin-dependent diabetes, is defined as a chronic immune-mediated disorder distinguished by the deficiency of insulin resulting from the destruction of the pancreatic islet β-cells with hyperglycemia (American Diabetes Association, 2014; Abutaleb, 2016).

Immune-mediated type 1 DM accounts for only 5-10% of individuals with DM. It can be diagnosed at any age but predominantly affects children and adolescents. The rate of β-cell destruction completely varies with this type of DM: it can be slow among some patients (mostly adults) and fast among others (specifically children and infants). For children under 18 years of age, the most prevalent type of autoimmune DM is characterized by a strong genetic susceptibility. Ketoacidosis may also develop as the initial indication of the disorder, particularly in adolescents and children. Modest fasting hyperglycemia may develop among other DM patients, in the presence of stress or infection and can quickly transition to ketoacidosis and/or severe hyperglycemia (American Diabetes Association, 2014; Abutaleb, 2016). However, other patients (especially adults) could maintain the adequate function of residual β-cells that block ketoacidosis for many years. Those patients will become at risk for ketoacidosis and rely on insulin for survival once these functioning β-cells stop working. Thus, there is no or little insulin secretion in this later

phase of the disorder, as indicated by undetectable or low C-peptide levels in plasma (American Diabetes Association, 2014).

Immune-mediated DM is typically considered to be hereditable, even though the bulk of patients do not have a family history of immune-mediated DM. In addition, autoimmune destruction of β-cells is associated with environmental characteristics that are yet not well understood and is likewise to also have numerous genetic tendencies (American Diabetes Association, 2014; Abutaleb, 2016).

Patients rarely suffer from obesity when having this type of DM, yet the existence of obese patients do not interfere with the diagnosis of this disorder. Those DM patients are too prone to additional autoimmune conditions like the following: pernicious anemia, vitiligo, Hashimoto's thyroiditis, myasthenia gravis, celiac sprue, Addison's disease, autoimmune hepatitis, and Graves' disease (American Diabetes Association, 2014).

B. Idiopathic Type 1 Diabetes Mellitus

In 1984, idiopathic type 1 DM was first recognized (Ahren and Corrigan, 1985). Then two subcategories of type 1 DM: (a) idiopathic type 1 DM and (b) classical autoimmune type 1 DM, were proposed by the ADA in 1997 (The Expert Committee on the Diagnosis Classification of Diabetes Mellitus, 1997). Most patients who fall into this category of type 1 DM are of Asian and African American descent. It has also been characterized in European Mediterranean, Hispanic Americans, and Native-American people. However, just a small fraction of individuals with type 1 DM are classified as idiopathic type 1 (Piñero-Piloña, Litonjua et al., 2001; Aguilera, Casamitjana et al., 2004; American Diabetes Association, 2014).

Idiopathic type 1 DM is distinguished by persistent insulinopenia and is strongly inherited, not associated with human leukocyte antigen (HLA), and missing immunological evidence of β-

cell autoimmunity (American Diabetes Association 2014; Herman, Petersen et al., 2017). Patients with idiopathic type 1 DM experience ketoacidosis episodes. Among those with regular ketoacidosis episodes, those patients also display various degrees of insulin insufficiency (Dcct Research Group, 1987; American Diabetes Association, 2014; Vellanki and Umpierrez, 2017).

Some distinctions do exist between patients with idiopathic type 1 DM and classical autoimmune type 1 DM, even though idiopathic type 1 DM patients typically have similar disease onset as classical autoimmune type 1 DM patients. Idiopathic type 1 DM patients have a distinguishing span of the disorder, with a principal need for insulin treatment, typically for 6 to 18 months, and following proper management of the metabolic condition with oral therapy (Banerji, Chaiken et al., 1994; Banerji, Chaiken et al., 1996; McFarlane, Chaiken et al., 2001; Piñero-Piloña, Litonjua et al., 2001).

1.2.2. Type 2 Diabetes Mellitus

The most common type of DM is Type 2 DM, which accounts for more than 90% of all DM cases in the world (International Diabetes Federation, 2021). Type 2 DM, formerly referred to as adult-onset diabetes, type II diabetes, or non-insulin-dependent diabetes, involve people with insulin resistance and generally have relative insulin deficiency (instead of absolute insulin deficiency) at least in the beginning of the disease (American Diabetes Association, 2014; Abutaleb, 2016). Those patients frequently do not require insulin therapy throughout their lifespan. However, to best avoid chronic complications and lower blood glucose, insulin therapy may eventually be required (American Diabetes Association, 2014; World Health Organization, 2019; International Diabetes Federation, 2021).

In Type 2 DM, hyperglycemia is the consequence, in the first instance of a situation known as insulin resistance (when body cells do not respond sufficiently to insulin). Insulin production

rises during a time when the effectiveness of the insulin hormone is diminished, accompanied by the onset of insulin resistance. With time, the pancreatic β-cells fail to keep up with the insulin demand resulting in insufficient insulin production (American Diabetes Association 2014; International Diabetes Federation, 2021).

An increasing number of adolescents and children are affected by Type 2 DM, though it is more prevalent among adults. Most Type 2 DM patients are obese or overweight, which aggravates or leads to insulin resistance. Type 2 DM patients who are not obese according to BMI criteria may instead have visceral obesity, which is a raised ratio of body fat allocation often in the abdominal region (Bogardus, Lillioja et al., 1985; Mooy, Grootenhuis et al., 1995; Stumvoll, Goldstein et al., 2005; American Diabetes Association, 2014; International Diabetes Federation, 2021).

1.2.3. Gestational Diabetes Mellitus

Gestational diabetes mellitus (GDM) is defined as any level of glucose intolerance that leads to hyperglycemia of variable riskiness that starts or first appears during pregnancy (American Diabetes Association, 2014; Kleinwechter, Schäfer-Graf et al., 2014; American Diabetes Association Professional Practice Committee, 2021). The description applies despite whether the insulin therapy is utilized or not, or the circumstances continue after gestation. It is not impossible that glucose intolerance existed before pregnancy, but it wasn't determined beforehand (American Diabetes Association, 2014).

Gestational diabetes mellitus prevalence could range from 1 to 14% of pregnancies globally (Qiu, Yu et al., 2017; Siddiqui and George, 2017). GDM affects 135,000 women in the United States each year, accounting for 4% of all pregnancies in the country (Terranova, 2007).

Furthermore, GDM is responsible for nearly 90% of all DM-complicated pregnancies (Kartik K. Venkatesh, 2021).

1.2.4. Other Specific Types of Diabetes Mellitus

According to the ADA, the etiological classification of other specific types of DM are as follows (American Diabetes Association, 2014):

A. Other genetic syndromes sometimes associated with diabetes can include the following: Laurence-Moon-Biedl syndrome, Prader-Willi syndrome, Wolfram's syndrome, Huntington's chorea, Turner's syndrome, Porphyria, Klinefelter's syndrome, Friedreich's ataxia, Down's syndrome, Myotonic dystrophy, and others.
B. Drug- or chemical-induced DM, which includes the following: β-adrenergic agonists, α-Interferon, thyroid hormone, pentamidine, diazoxide, glucocorticoids, vacor, thiazides, nicotinic acid, Dilantin, and others.
C. Genetic defects of β-cell function, which include the following: chromosome 2, NeuroD1 (MODY6), chromosome 20, HNF-4α (MODY1), chromosome 7, glucokinase (MODY2), chromosome 12, HNF-1α (MODY3), Mitochondrial DNA, chromosome 17, HNF-1β (MODY5), chromosome 13, insulin promoter factor-1 (IPF-1; MODY4), and others.
D. Diseases of the exocrine pancreas, which include the following: aldosteronoma, hemochromatosis, neoplasia, pancreatitis, fibrocalculous pancreatopathy, cystic fibrosis, trauma/pancreatectomy, and others.
E. Uncommon forms of immune-mediated diabetes, which include the following: anti-insulin receptor antibodies, stiff-man syndrome, and others.

F. Endocrinopathies, which include the following: hyperthyroidism, aldosteronoma, glucagonoma, acromegaly, somatostatinoma, pheochromocytoma, Cushing's syndrome, and others.

G. Genetic defects in insulin action, which include the following: lipoatrophic diabetes, leprechaunism, type A insulin resistance, Rabson-Mendenhall syndrome, and others.

H. Infections, which include the following: cytomegalovirus, congenital rubella, and others.

1.3. Diagnosis of Diabetes Mellitus

According to the ADA, the patient is diagnosed with diabetes if one or more of the following criteria are met (American Diabetes Association Professional Practice Committee, 2021):

- In a patient who has a hyperglycemic crisis or classic symptoms of hyperglycemia, a random plasma glucose level of 11.1 mmol/L (200 mg/dL) or higher.
- Fasting plasma glucose (FPG) level of 7.0 mmol/L (126 mg/dL) or higher. Fasting is defined as not eating or drinking for at least 8 hours.
- Glycosylated hemoglobin (A1C) level of 48 mmol/mol (6.5%) or higher (The test should be conducted in a laboratory using a process that is National Glycohemoglobin Standardization Program (NGSP) standardized and certified to the Diabetes Control and Complications Trial (DCCT) assay).
- Two-hour plasma glucose (2-h PG) level of 11.1 mmol/L (200 mg/dL) or higher during oral glucose tolerance test (OGTT) (The test should be conducted as described by the World Health Organization (WHO); utilizing a glucose load containing the equal of 75 g anhydrous glucose dissolved in water).

Diagnosis demands two abnormal results from two separate samples or the same sample when unequivocal hyperglycemia cannot be established.

According to the ADA, the patient is diagnosed with prediabetes (prediabetes described as a condition that places people at increased risk of developing DM and DM-related complications) if one or more of the following criteria are met (American Diabetes Association Professional Practice Committee, 2021):

- A1C level from 39 mmol/mol (5.7%) to 47 mmol/mol (6.4%).
- 2-h PG during 75-g OGTT level from 7.8 mmol/L (140 mg/dL) to 11.0 mmol/L (199 mg/dL) (Impaired Glucose Tolerance (IGT)).
- FPG level from 5.6 mmol/L (100 mg/dL) to 6.9 mmol/L (125 mg/dL) (Impaired Fasting Glucose (IFG)).

According to the ADA, a patient is diagnosed with GDM by a one-step strategy, or a two-step strategy as follows:

- **One-step strategy:** Between 24 and 28 weeks of pregnancy, women who have never been diagnosed with diabetes have a 75-gram OGTT, with plasma glucose levels tested after the patient has fasted for 1 to 2 hours. After overnight fasting for at least 8 hours, an OGTT is conducted in the morning. The patient is diagnosed with GMD if one or more of the following criteria are met (American Diabetes Association Professional Practice Committee, 2021):
    - 2 h: level of 8.5 mmol/L (153 mg/dL) or higher.
    - 1 h: level of 10.0 mmol/L (180 mg/dL) or higher.
    - Fasting: level of 5.1 mmol/L (92 mg/dL) or higher.

- **Two-step strategy**

  Step One: For women who were not prior diagnosed with DM between 24 and 28 weeks of gestation, a 50-g Glucose Load Test (GLT) (non-fasting) is performed, with plasma glucose measured at 1 h. After one hour, if the load of the plasma glucose level measured is equal to 7.2, 7.5, or 7.8 mmol/L (130, 135, or 140 mg/dL, respectively) or higher, move to a 100-g OGTT (American Diabetes Association Professional Practice Committee, 2021).

  Step Two: When the patient is fasting, the 100-g OGTT should be performed. The patient is diagnosed with GMD if two or more of the following criteria are met (Carpenter and Coustan 1982; American Diabetes Association Professional Practice Committee, 2021):

    - 3 h: level of 7.8 mmol/L (140 mg/dL) or higher.
    - 2 h: level of 8.6 mmol/L (155 mg/dL) or higher.
    - 1 h: level of 10.0 mmol/L (180 mg/dL) or higher.
    - Fasting: level of 5.3 mmol/L (95 mg/dL) or higher.

The American College of Obstetricians and Gynecologists remarks that one raised value can be utilized for GMD diagnosis (Bulletins-Obstetrics, 2018).

1.4. Diabetes Mellitus Risk Factors

The risk factors that increase the development of DM differ depending on the kind of DM a patient has and will be discussed in the next few sections.

1.4.1. Risk Factors for Type 1 Diabetes Mellitus

Risk factors for Type 1 DM include the following: physical stress (like illness or surgery), autoantibody presence (antibodies that erroneously attack patients' body's organs or tissues), family history (having a sibling or parent with type 1 DM), exposure to viruses' infections,

pancreas injury (by accident infection, surgery, or tumor), and\or age (more potential to develop at a child, teen, or young adult age) (Mayo Clinic Staff, 2020; Centers for Disease Control and Prevention, 2021; Cleveland Clinic, 2021).

1.4.2. Risk Factors for Type 2 Diabetes Mellitus and Prediabetes

Risk factors for Type 2 DM and prediabetes include the following: race (Hispanic/Latino American, Pacific Islander, Asian-American, or African-American), family history (having a sibling or parent with type 2 DM, or prediabetes), high blood pressure, physically inactive, overweight, low high-density lipoprotein (HDL) cholesterol, polycystic ovary syndrome, cigarette smoking, age (45 or older), history of stroke or heart disease, high triglyceride level, and\or gestational diabetes or delivering a baby who weighed more than nine pounds (Mayo Clinic Staff, 2020; Centers for Disease Control and Prevention, 2021; Cleveland Clinic, 2021).

1.4.3. Risk Factors for Gestational Diabetes Mellitus

Risk factors for gestational diabetes include the following: race (Pacific Islander, Alaska Native, Hispanic/Latino American, African American, Native Hawaiian, or American Indian), family history (having a sibling or parent with type 2 DM, or prediabetes), age (more than 25 years old), overweight, and\or polycystic ovary syndrome (Mayo Clinic Staff, 2020; Centers for Disease Control and Prevention, 2021; Cleveland Clinic, 2021).

1.5. Epidemiology

Worldwide, the number of DM patients increased by 10.5% from 382 million in 2013 to 422 million in 2014 and increased by 2.91-fold between 1980 and 2014 (Shi and Hu, 2014; Melmed, Polonsky et al., 2015; World Health Organization, 2018). Zhou, Lu et al., (2016) explained the dramatic increase in the number of DM patients as 39.7% due to aging and population growth, 28.5% because of increased prevalence, and 31.8% resulting from the

interaction between these two factors. Globally, in 2021, it is estimated that 537 million individuals have DM, which equals 10.5% of the worldwide adult population. By the years 2035, 2040, 2045, it is expected that the number of individuals with DM will increase to 592 million, 642 million, 783 million, respectively (International Diabetes Federation, 2021).

Globally, from 1980 to 2014, the prevalence of DM has risen by 80.9% from 4.7% to 8.5%. During the past three decades, the prevalence of DM has been steadily growing with low-and middle-income countries growing faster than in high-income countries (World Health Organization, 2018). A previous study found that the worldwide age-standardized DM prevalence was estimated to have increased from 1980 to 2014 by 58.0% among women from 5.0% (95% CI 2.9–7.9) to 7.9% (95% CI 6.4–9.7), and by 109.3% among men from 4.3% (95% CI 2.4–7.0) to 9.0% (95% CI 7.2–11.1) (Zhou, Lu et al., 2016). Out of every ten people in the world, more than one adult currently lives with DM. In addition, there is a rising list of countries in which out of every five, one or more of the adult inhabitants has DM (International Diabetes Federation, 2021). Additionally, a previous study that was conducted in the UK reported that there is a sharp increase in the rate of hospital admission related to hyperglycemia in the past two decades (Naser, Wang et al., 2018).

1.6. Mortality

Diabetes mellitus ranks among the leading ten reasons for death worldwide (International Diabetes Federation, 2021). Diabetes mellitus caused a death rate of 1.5 to 5.1 million individuals annually between the global population in 2012 and 2013, becoming the top eighth reason for mortality in the world (World Health Organization, 2018). Among diabetic patients, DM at least doubles the risk of mortality. Diabetes mellitus patients are at risk of developing many life-threatening and debilitating complications (Alwafi, Alsharif et al., 2020), thus, causing a reduced

quality of life, premature death (i.e., before the age of 70), and a raised necessity for medical care (International Diabetes Federation, 2021). The premature death rate from DM increased by 5% between 2000 and 2016. Diabetes mellitus directly caused 1.5 million deaths in 2019, where deaths before the age of 70 accounted for 48% of all deaths due to DM (World Health Organization, 2021). In 2021, among the ages of 20-79, it is estimated that about 6.7 million adults have died from DM or its complications [except for the risks of deaths connected with the coronavirus disease 2019 (COVID-19) pandemic]. Where deaths under the age of 60 accounted for 32.6% of all deaths due to DM during 2021 (International Diabetes Federation, 2021).

According to the WHO, DM associated risk factors (like being obese or overweight) are growing. Moreover, the WHO has found that DM is a substantial reason for lower limb amputation, kidney failure, blindness, and further long-term complications that significantly influences the quality of life. Hence, the rates of limb amputation are higher among DM individuals by 10 to 20 times (World Health Organization, 2018).

1.7. Economic Burden

Over the past 15 years from (2006 to 2021), international health spending due to DM has significantly increased by 3.2-fold from $232 billion to $966 billion for adult patients aged 20 to 79 years. Improving data quality could be the reason in part for this increase. The direct costs of diabetes and its complications are expected to continue to grow (Naser, Alwafi et al., 2020; International Diabetes Federation, 2021). Compared to 2021, the International Diabetes Federation assumes that the entire DM-related health spending will rise by 66.4% by 2030 and 9.1% by 2045, reaching $1.03 trillion and $1.05 trillion, respectively (International Diabetes Federation, 2021).

1.8. Management of Diabetes Mellitus

- **Treatment Goals:** Treatment goal guidance from the American Association of Clinical Endocrinologists and American College of Endocrinology (AACE/ACE) and ADA are alike. For general individuals with DM, the ADA treatment goals involve the following criteria (American Diabetes Association Professional Practice Committee, 2021):
    - Peak postprandial glucose less than 10.0 mmol/L (180 mg/dL).
    - A1C less than 8% for people with specific comorbidities or severe hypoglycemia, less than 6.5% for select healthy people; equal or less than 7% for most.
    - Blood pressure less than 130/80 for some healthy people; less than 140/90 mmHg for most (American Diabetes Association Professional Practice Committee, 2021).
    - Pre-prandial glucose level from 4.4 to 7.2 mmol/L (80–130 mg/dL).

Concerning glycemic goals among women who have DM before gestation, ADA recommendations include the following (American Diabetes Association, 2014):

- A1C less than 6.0%.
- Peak postprandial glucose level from 5.4 to 7.1 mmol/L (100–129 mg/dL).
- Bedtime, premeal, and overnight glucose level from 3.3 to 5.4 mmol/L (60–99 mg/dL).

For pregnant DM patients, treatment goals are slightly different from the general DM patients. According to the ADA, the glycemic goals for GDM patients include pre-prandial of less than 5.3 mmol/L (95 mg/dL) and either of the following (American Diabetes Association Professional Practice Committee, 2021):

- 2-hour after meal less than 6.7 mmol/L (120 mg/dL).
- OR 1-hour after meal less than 7.8 mmol/L (140 mg/dL).

a. Pharmacological Management

Type 1 DM demands direct initiation of insulin treatment: insulin with meals or prandial insulin, and basal insulin (rapid-acting insulin with a pump, or long-acting or intermediate by injection). For sufficient glycemic control, several insulin injections throughout the day are required (Handelsman, Bloomgarden et al., 2015; American Diabetes Association Professional Practice Committee, 2021)

For Type 2 DM patients, metformin is recommended for management unless contraindicated or not tolerated. When oral antidiabetic agents as monotherapy or combination therapy (such as the following: glucagon-like peptide-1 (GLP-1) agonists, sulfonylureas, sodium-glucose cotransporter 2 inhibitors, alpha-glucosidase inhibitors, dipeptidyl peptidase 4 inhibitors, and thiazolidinedione) is not efficacious among patients with Type 2 DM, usually insulin therapy is demanded (Naser, Wong et al., 2018). If a patient with Type 2 DM has symptoms of hyperglycemia (frequent urination, increased thirst) and has A1c greater than 9.0%, they may even start with insulin therapy. To avoid hypoglycemia and achieve proper glycemic control with prandial insulin, it is important to balance the intake of carbohydrates (Handelsman, Bloomgarden et al., 2015; American Diabetes Association Professional Practice Committee, 2021).

Pharmacologic treatment of DM during gestation varies among individuals. The standard therapy for DM during gestation is insulin. Some oral medications have been used during gestation without adverse side effects among some patients, including metformin and glyburide (Handelsman, Bloomgarden et al., 2015; American Diabetes Association Professional Practice Committee, 2021; American Diabetes Association Professional Practice Committee, 2021).

b. Non-Pharmacological Treatment

Along with reducing blood glucose and the levels of further known risk factors that impair the blood vessels, treatment of DM involves physical activity and a healthy diet (World Health Organization, 2021). Smoking cessation is even a more significant change to avoid DM complications (World Health Organization, 2021).

Chapter 2: Literature Review

2.1 Overview

An essential part of implementing and maintaining the use of guidelines is understanding how physicians behave toward guidelines. Chapter 2 discusses what previous studies have found on physicians' behavior towards utilizing diabetes clinical guidelines while managing patients with diabetes mellitus.

2.2 Literature Review

Published evidence suggested that properly utilizing clinical practice guidelines for Type 2 diabetes can improve glycemic control, lipid profiles, and patient satisfaction with their care (Goldfracht & Porath, 2000; Kirkman et al., 2002; Gross et al., 2003). The utilization of unnecessary medications and procedures that provide little or no benefit is reduced when medical standards of care are followed. This practice enhances cost-effectiveness, which is a top priority in developing countries with limited healthcare budgets and resources that are already under financial strain. Policymakers and managers use standards of care to plan health services, resource allocation, and organizational development (National Health and Medical Research Council (Australia), 1999; Leach & Segal, 2010).

Even though Type 2 diabetes clinical guidelines are readily available, several studies have found that healthcare practitioners follow them inconsistently. The proportion of people with Type 2 diabetes who met ADA-recommended levels of glycated haemoglobin, blood pressure, and Low-Density Lipoprotein (LDL) cholesterol was examined in a large cross-sectional study using data from the National Health and Nutrition Examination Surveys (NHANES) in the United States (Stark Casagrande, 2013). Only 18% of patients with Type 2 diabetes who completed self-

administered surveys between 1988 and 2010 met the recommended treatment goals (Stark Casagrande, 2013). The researchers concluded that following the guidelines had a substantial impact on their findings.

In a retrospective cohort study that used electronic health record data of 4,994 adults (age> 18 years) with Type 2 diabetes who visited Patisserie Teaching Hospital in South Korea between 2004 and 2009, Se-Won Oh et al., (2011) found that the proportion receiving routine screening for eye disease, lipid abnormalities, and renal dysfunction were 32.8%, 45.9%, and 33.5%, respectively. The investigators concluded that physicians were not sufficiently following the clinical guidelines.

Despite their positive attitude toward clinical guidelines, many physicians do not follow them (Farquhar et al., 2002). In persons with Type 2 diabetes, non-adherence can lead to suboptimal treatment and needless investigations. Examining physicians' knowledge and perceptions of guideline utility was crucial to enhance their adherence to and understanding of the most up-to-date practice recommendations (Storm□Versloot et al., 2012). In previous studies conducted in Saudi Arabia to assess physicians' perceptions toward diabetes clinical practice guidelines, attitudes toward clinical guidelines were generally positive (Amer et al., 2019;Wahabi, 2011). A cross-sectional study of 260 physicians and nurses working in the pediatrics department at King Khalid University Hospital investigated their perceptions and attitudes toward diabetic ketoacidosis guidelines. Clinical guidelines were viewed as a 'useful tool' for practice by nearly all (99%) respondents because they promoted uniformity and safety while lowering patient risks. Furthermore, 98% of physicians reported that they have confidence in clinical guidelines. The study concluded that positive perceptions and attitudes of evidence-based guidelines are crucial to their implementation and sustaining a safe and high-quality healthcare environment (Amer et al.,

2019). Another study in Saudi Arabia by Wahabi et al.(2011) reported that physicians had a positive attitude towards clinical practice guideline (CPG)s with 90% believing that CPGs integrate patient care and 96% agreeing that CPGs increase the quality of services provided (Wahabi, Alzeidan et al., 2011). The respondents' experience with CPGs matched their attitudes and opinions. CPGs have changed the way they manage their patients, according to 86.3% of respondents, and 71.8% reported they have already employed CPGs in patient management. Physicians were substantially less likely than nurses to utilize CPGs in practice ($p \leq 0.05$). Additionally, the usage of guidelines varies greatly depending on years of experience, with 71% of respondents with 15 years or more experience using CPGs in their patient treatment compared to 60% among respondents with fewer years of experience ($p<0.05$) (Wahabi, Alzeidan et al., 2011).

Each phase in the implementation of guidelines, according to Grol et al., (1992), may contain barriers that need to be better understood iorder to develop solutions to overcome them. Furthermore, Grol et al. suggested that these barriers could be due to both individual practitioner characteristics (e.g., motivation, age and experience, attitude, learning style, willingness to change, and self-confidence) and the context in which they practice (logistics and also structure, social, and organizational factors) (Grol, 1992).

Table 1: Literature Review Findings

Study author (year)	Country	Study Design	Study Aim	Sample Size	Physicians Specialty / Settings	Findings related to physicians' adherence/perception/ use of clinical guidelines while managing patients with diabetes mellitus type 2	Findings related to barriers and interventions used to improve physicians adherence/perception /use of clinical guidelines while managing patients with diabetes mellitus type 2
(Amer, Nemri et al. 2019)	Saudi Arabia	Cross-sectional survey	To explore perception, attitude, and satisfaction of paediatric clinicians, trainees, and nurses at King Khalid University Hospital towards clinical practice guidelines (CPGs) including the locally adapted diabetic ketoacidosis CPG (DKA-CPG).	260	Doctors and nurses working in the paediatrics department.	The respondents had a good attitude toward general clinical practice guidelines (CPGs) and specifically the diabetic ketoacidosis (DKA) CPG; 98.7% believed CPGs were effective sources of information, enhanced safety and risk, and reduced variation in practice. A total of 99.2% of respondents thought CPGs were good clinical tools, 98.3 percent were satisfied with, had trust in, and would promote CPGs to their colleagues, and 94.6% agreed they were cost effective. Paper (46.6%) and electronic were the most popular formats for CPGs (42.9%). The DKACPG aided in	They identified a number of factors that may have contributed to the positive perceptions and attitudes toward CPGs. The context or health care setting at the institution, which is a university teaching medical complex where evidence-based medicine and CPGs are part of the undergraduate and postgraduate medical school curricula, was one of these. In addition, the paediatrics department has been engaged in continual quality improvement projects and efforts as a result of national and international accreditation activities.

						patient management, and all responders were satisfied and confident in it (100%). Physicians reported a more positive attitude of CPGs in general (P≤0.05) and the DKACPG (P≤0.05) than nurses.	
(Wahabi, Alzeidan et al. 2011)	Saudi Arabia	Cross-sectional survey	To explore the opinion and practice of the health care providers in King Khalid University Hospital (KKUH) towards clinical practice guidelines (CPGs).	2225	Health care professionals in King Khalid University Hospital	Physicians had a positive attitude towards CPGs with 90% believing that clinical practice guideline (CPG)s integrate patient care and 96% agreeing that CPGs increase the quality of services provided The respondents' experience with CPGs matched their attitudes and opinions. CPGs have changed the way they manage their patients, according to 86.3% of respondents, and 71.8% reported they have already employed CPGs in patient management. Physicians were substantially less likely than nurses to utilize CPGs in practice	They reported that certain circumstances improve health care providers' use and adherence to CPGs, such as when the guideline's source is a credible and respected body or organization, when there is consensus about the benefit to patients, and when supplies for implementation, such as medicine and equipment, are available.

						($p \leq 0.05$); also, the usage of guidelines varies greatly depending on years of experience, with 71% of respondents with 15 years or more experience using CPGs in their patient treatment compared to 60% among respondents with less years of experience ($p<0.05$)	
Rätsep, Kalda et al. (2006)	Estonia	Cross-sectional survey	To compare family physicians' information and self-reported care of patients who have type 2 diabetes with the recommended criteria of the clinical practice guidelines (CPGs).	163	Family doctors	76% of the responding family physicians had a copy of the guideline. 79% of responding family physicians reported utilizing it in daily practice. 83% of the responding family physicians considered guideline viable.	Not applicable.
Gannon, Qaseem et al. (2010)	Pennsylvania, USA	Longitudinal study (pre-post intervention design)	The main research objective of this study was to investigate the effect of an educational	112 physicians 1172 patients with type 2 diabetes	Health Organization in Pennsylvania	Not mentioned.	The Web-based educational module consists of 13 chapters on diabetes education, screening for microalbumin, diagnosis, blood pressure, glycemic

			intervention on clinical consequences in type 2 diabetes patients.				control, exercise programs, weight loss, lipids, vaccinations, dilated eye examination, foot examination, and smoking cessation. Each chapter contains information and a review test. In addition, self-assessment and practice tools (patient education and enabling tools) are incorporated in this module. There is an exhaustive self-assessment part with case studies at the end of the module. When new evidence becomes available, the module is updated online. This study showed the efficacy of utilizing Web-based mediums to modify physician behaviour and reinforce the utilization of clinical guidelines. Research outcomes indicated persistent improvements in most clinical consequences.
Khan, Lateef et al. (2011)	Saudi Arabia	Cross-sectional survey	To evaluate the Knowledge Attitude and	99	General practitioners (GPs) Urban, and rural area.	41% GPs had a copy of CPGs.	This study advised the necessity for understanding and educational program to

			Practice (KAP) of the ministry of health (MOH) primary health care (PHC) medic in the managing of type 2 diabetes.			Overall KAP score of GPs who did not have a copy of CPGs in n their clinic was (65.10 ±7.01, P=.005), which was lower than the KAP score of GPs who had a copy of CPGs (70.90 ±10.94). Practice score of GPs who did not have CPG in their clinic scored remarkably lower than GPs who had CPG in their clinic (16.55 ± 7.34, vs 20.57 ± 7.54, P< 0.003)	update GPs (particularly female, Saudi doctors, and those practicing in urban places) on the diagnostic criteria and epidemiology for Type 2 diabetes and Diabetic Self-Management Education (DSME), prevention of diabetes complications of Type 2, adherence to CPG, insulin injection practice, and effective diabetes treatment.
Beaser, Okeke et al. (2011)	United States	Cross-sectional survey	To identify the behavioral, competence, and knowledge issues among diabetes specialists and primary care providers (PCPs) concerning the application and use of evidence-based clinical guidelines and to conform care between	249 diabetes specialists and 491 PCPs.	Internal medicine, family medicine, nonendocrine specialist primary care provider, diabetologist, endocrinologist, obstetrician/gynecologist, and others.	18% of specialists and 36% of PCPs continually utilized treatment algorithms and clinical guidelines for managing judgments concerning their type 2 diabetes patients.	This study recommended that performance-based educational interventions and quality-based educational interventions are needed.

			diabetes specialists and PCPs especially connected to referral practices for Type 2 diabetes patients.				
Satman, Imamoglu et al. (2012)	Turkey	National, multi-Centre retrospective study	To assess doctors' compliance to guidelines by Diabetes Study Group of The Society of Endocrinology and Metabolism of Turkey (SEMT).	180 physicians 1790 patients with type 2 diabetes	Endocrinologist, internist, and family practitioner. Various types of hospitals in all Turkey geographical areas.	Overall physicians' adherence to guidelines was suboptimal. Approximately 50% of patients obtained a high level of care congruent with SEMT guidelines (>75% guidelines adherents). Guidelines adherence among physicians and specialists practicing in university settings was higher than those practicing in other settings.	The study inferred adherence to guidelines can improve by educational programs that focus on the preventative part of managing diabetes. which ultimately improve patient outcomes.
Muzaffar, Fatima et al. (2013)	Karachi, Pakistan	Retrospective study	To monitor healthcare professionals' compliance to the 2004 ADA guidelines for the care of type 2 diabetes patients in Karachi in	691 patients with type 2 diabetes	Healthcare professionals	Healthcare professional's adherence to guidelines was suboptimal. The recommended ADA goals were achieved as follows: HDL in 4.9% of patients, LDL in 12.2% of patients, blood pressure in 13.0% of patients, triglyceride in 13.3%	Not applicable.

			peripheral diabetes clinics (PDCs).			of patients, postprandial plasma glucose in 17.7% of patients, cholesterol in 27.5% of patients, pre-prandial plasma glucose in 47.8% of patients, and HbA1c in 59.0% of patients.	
Widyahening, Van Der Graaf et al. (2014)	Indonesia	Cross-sectional survey	To evaluate the degree of physicians' adherence, awareness, adoption, and agreement to guidelines for type 2 diabetes in Indonesia and their connection with respondent characteristics.	399	GPs Academic hospital, solo practice, public health centre, private clinic, public hospital (non-academic), and private hospital.	89% of GPs were aware of the presence of Indonesian guidelines for type 2 diabetes. 66% to 91% of GPs were aware of each recommendation of Indonesian guidelines for type 2 diabetes. A high understanding of the guideline does not always result in adherence to guideline recommendations or adoption guidelines. The publication and production of guidelines alone are not adequate to guarantee the implementation of the research evidence.	The study inferred that improving clinicians' agreement with, adoption of, and understanding of guidelines necessitate integrating into programs to enhance adherence to the guideline.
Thepwongsa, Kirby et al. (2014)	Australia	Cross-sectional survey	To evaluate existing KAP in managing type 2 diabetes for GPs in the	209	GPs	66.7% of GPs had utilized guidelines "the Diabetes management in general practice: Guideline for type 2	Only 1.5% of GPs were presently registered in education or further specialized training for the

			remote and rural Australian areas to deliver attentive education initiatives.			diabetes 2011/12" in their daily practices. 28.9% of GPs had not utilized the guidelines. 4.4% of GPs had not heard of these guidelines.	management of diabetes. 67.0% of GPs declared on their learning necessities. The study indicated that the preferences of GPs in persisting medical information and education may enable forthcoming activities to meet the necessities of GPs, particularly in remote and rural areas.
Corriere, Minang et al. (2014)	United States	Online questionnaire	To define how often guidelines are utilized and the association to physicians' diabetes-related decision making and knowledge.	383	Primary care, endocrinologist, and other.	53% of physicians routinely use diabetes guidelines. This study found considerable gaps in understanding diabetes treatments and diabetes-linked knowledge in practicing physicians. However, the diabetes knowledge score for physicians who don't use guidelines was significantly lower than physicians who use guidelines (2.76 ± 0.084 vs 3.37 ± 0.072; $p < 0.001$). Moreover, physicians who use guidelines were extremely more likely	The study points to the necessity for enhancing continuous medical education among medical practitioners and potential training in the treatment and management of diabetes.

						to report a proper understanding of Type 2 diabetes medicines (OR = 2.99, 95% CI 1.95-4.61; p < 0.001).	
Oude Wesselink, Lingsma et al. (2015)	Netherlands	Cross-sectional study	To investigate the connection between adherence to guidelines and patients' health consequences also to determine adherence to guidelines among GPs who provide care for Type 2 diabetes patients in Dutch.	32 GPs 363 patients with Type 2 diabetes	GPs	In Dutch, the adherence to guidelines among GPs who provide care for Type 2 diabetes patients was not optimal. This study did not find a clear association between adherence to the guidelines and health consequences.	Not applicable.
Alkhiari, Alzayer et al. (2018)	Hamilton, Ontario, (Canada)	Retrospective longitudinal study	To evaluate the present Canadian practice guidelines compliance level for the pharmacological managing of inpatients with Type 2 diabetes, and whether it impacts the recurrence of	108 patients with type 2 diabetes	Medical student/junior resident, senior resident, and attending physician. Two academic teaching hospitals in Hamilton, Ontario.	82% of patients received care based on guidelines. Adherence level to the current Canadian guidelines for managing Type 2 diabetes inpatient is good. Around one-third of junior residents did not follow the guidelines.	The study inferred that the compliance level is better with more clinical seniority and training.

			hypoglycemia or hyperglycemia.				
Bili and Zha (2018)	Juba, South Sudan	Descriptive cross-sectional study	To evaluate the level of compliance and knowledge to guidelines for managing Type 2 diabetes and determine connections between HbA1C levels and scores of knowledges.	176 adult's patients with Type 2 diabetes	The Malakia Diabetic Control Centre of Juba.	Adherence to guidelines was low. In the past year, only 10.2% of patients had kidney function reviews, 20.5% had dental examinations, 37.5% had lipid measurements, 44.3% had HbA1c tests, and 46.6% had retinal examinations. Knowledge about guidelines was poor.	The study inferred that in South Sudan, the educational intervention and execution of guidelines for diabetes management are consequential.
Franch-Nadal, García-Gollarte et al. (2019)	Spain	Cross-sectional study.	To clarify routine clinical practice and perceptions of community pharmacists and physicians in the management of elderly patients with Type 2 diabetes.	999 community pharmacists and 993 physicians.	Community pharmacists (with at least two years' experience in Spain; in the community pharmacy domain). Public health sector physicians in Spain (with a minimum of two years' experience in their specialty).	Adherence to guideline recommendations was low. A total of 62.8% of physicians reported that they follow the clinical guidelines recommendations. Contingent on physicians' prescribing decisions for hypothetical patients, less than 50% of physicians were consistent with the guideline recommendations. HbA1c targets (according to the clinical guidelines)	Not applicable.

						were defined by only 28.7% and 38.9% of clinicians for frail patients and elderly patients, respectively.	
Savona-Ventura and Vassallo (2019)	Mediterranean region countries	Cross-sectional survey	To evaluate compliance of practitioners working in the Mediterranean region to the guidelines and determine causes for non-adherence.	2841	Diabetologist/endocrinologist, primary health physician, cardiologist/internist, and others. Primary health, university hospital, general hospital, and others.	79.2% of physicians were aware of local guidelines.	Not applicable.
Gediminas, Ida et al. (2019)	Lithuania	Retrospective study	To examine the adherence of the Lithuanian family physician with the national type 2 diabetes guidelines and to evaluate the associations between guidelines adherence and health care practice features and patients.	382 patients with type 2 diabetes 6 private and 4 public PHC medical records	Family physician	Adherence to type 2 diabetes guidelines in Lithuanian PHC is not optimal. Annual BMI and LDL checks were performed only among 19.4% and 23.8% of patients, respectively. Endocrinologist consultation was provided only to 49.5% of patients.	Not applicable.

Daud, Ramli et al. (2020)	Malaysia	Pragmatic Cluster Randomized Controlled Trial	To assess the efficacy of the EMPOWER-participatory action research (PAR) intervention, a multifaceted approach contingent on the chronic care model (CCM) on PCP compliance to CPG of Type 2 diabetes in the Malaysian general primary care setting.	20 clinics. 888 patients with Type 2 diabetes.	Family Medicine Specialists (FMS)	Not mentioned.	EMPOWER-PAR consists of support, CDM workshops, self-management support tool, type 2 DM CPG, and facilitation. EMPOWER-PAR intervention has effectively improved the adherence of PCPs to CPG of type 2 diabetes in numerous indicators of care. Conclusions from this study delivered factual evidence of the efficacy of a multifaceted intervention contingent on the CCM in the general primary care setting in Malaysia.
Brenner, Oberaigner et al. (2020)	Germany	Cross-sectional survey	To catch the physician viewpoint on compliance to Type 2 diabetes guidelines and determine factors for raising compliance.	46	Specialist (inpatient, and outpatient), and GP.	93% of participants have very good or good knowledge about national treatment guidelines.	Doctors have rated several potential barriers for adherence to the guidelines, including the following: 41% physician disapproval of guideline, 35% medical reasons, 41% due to missing clinical information, 50% due to deficient physician training, 54% non-alignment of guideline and reimbursement, and 63% deficient

							cross-sectoral coordination. In this study, clinicians valued adherence enablers contingent on digital solutions to decrease the intricacy of treatment determinations and aid the care approach.
Papanas, Elisaf et al. (2020)	Greece	Nationwide, multi-Centre, cross-sectional study	To estimate adherence of doctor to the patient follow-up protocol (PFP) of the 2017 Hellenic Diabetes Association (HDA) guidelines, and even evaluated control achievement rates for lipid, blood pressure, and glycated hemoglobin (HbA1c) in the routine care environment in Greece.	4 GPs with an express interest in diabetes, 14 endocrinologists, 35 internists, and 610 patients with Type 2 diabetes.	Endocrinologists, GPs, and internists.	Physicians followed the: American Association of Clinical Endocrinologists/American College of Endocrinology (AACE/ACE) guidelines for managing 8.8% of patients, American Diabetes Association/European Association for the Study of Diabetes (ADA/EASD) guidelines for managing 43.4% of patients, and HDA therapeutic guidelines for managing 77.2% of patients.	Not applicable.

Bimpas, Auyeung et al. (2021)	Greece	Questionnaire	To assess the level of adherence and adoption of Greek physicians to the HDA guidelines for the management of Type 2 diabetic people.	226	GPs, internists, endocrinologists, and others. Public hospital, private setting, and both public hospital and private setting.	92.2% of participants adopt/ follow HDA guidelines. 26.1% of participants adherence to both treatment and general guidelines.	Adherence to treatment guidelines is positively affected by the rate of attendance to diabetes seminars. Adherence to treatment guidelines is negatively affected by long professional practice.
Gimeno, Cánovas et al. (2021)	Spain	Cross-sectional multicenter study	To evaluate factors correlated with adherence to Type 2 diabetes clinical practice guidelines (CPGs).	98	Endocrinologists	All of the participants were knowledgeable and utilized CPGs in day-to-day practice as follows: 8.2% use "the CPG for the Prevention and Management of Diabetes in, Canada, Professional Section of Diabetes Canada", 10.2% use the National Institute for Health and Care Excellence (NICE) for management adults with Type 2 diabetes, 34.7% use the Spanish Society of Diabetes (SED) recommendations for treatment of hyperglycemia in type 2 diabetes (pharmacological treatment), 38.8% use the AACE/ACE	Not applicable.

						"comprehensive type 2 diabetes management algorithm", 79.6% use the Spanish Society of Endocrinology and Nutrition (SEEN) in the care of Type 2 diabetes patients, and 99% use the ADA/EASD in the care of Type 2 diabetes patients.	

Much of the research mentioned above found varying results in terms of physicians' and general practitioners' adherence to Type 2 diabetes guidelines in various countries. Some studies reported that clinical guidelines adherence was good (Rätsep, Kalda et al., 2006; Thepwongsa, Kirby et al., 2014; Alkhiari, Alzayer et al., 2018; Papanas, Elisaf et al., 2020; Gimeno, Cánovas et al., 2021), while others reported that clinical guidelines adherence was low or suboptimal (Beaser, Okeke et al., 2011; Satman, Imamoglu et al., 2012; Muzaffar, Fatima et al., 2013; Oude Wesselink, Lingsma et al., 2015; Bili and Zha 2018; Franch-Nadal, García-Gollarte et al., 2019; Gediminas, Ida et al., 2019). In addition, several studies have noted a high awareness of the guidelines for Type 2 diabetes. According to several studies, a thorough knowledge of the principles does not always imply adherence or adoption (Widyahening, Van Der Graaf et al., 2014; Franch-Nadal, García-Gollarte et al., 2019; Bimpas, Auyeung et al., 2021).

Bimpas, Auyeung et al., (2021) concluded that adherence to treatment guidelines was negatively affected by long professional practice, while Alkhiari, Alzayer et al., (2018) found that it was positively affected by more clinical seniority. Additionally, Gannon, Qaseem et al., (2010) have found a relationship between adherence to guidelines and health outcomes. On the other hand, Oude Wesselink, Lingsma et al., (2015) have not found a clear connection between guidelines adherence and health consequences. Patient non-adherence, individual patient characteristics, a lack of knowledge, time constraints, flaws in the health-care system, insufficient human resources, referral system difficulties, and a refusal to change practice are some of the reasons or barriers that led to non-adherence to clinical guidelines (James, Cowan et al., 1997; Larme and Pugh 1998; Chan, Ghazali et al., 2005; Gimeno, Cánovas et al., 2021).

Several interventions have been recommended and used to improve adherence of clinical guidelines during the management of Type 2 diabetes patients and have had a positive effect. For

instance, a previous study found a significant increase in physician adherence to clinical guidelines for Type 2 diabetes after educating physicians about the Society of Endocrinology and Metabolism of Turkey (SEMT) guidelines, which resulted in more rational treatment preferences, fewer unnecessary treatments, and better glycemic control (Satman, Imamoglu et al., 2012). Moreover, web-based medium and the EMPOWER-PAR intervention utilization enhanced physician's adherence to Type 2 diabetes guidelines and improved clinical outcomes for patients in Malaysia and the Pennsylvania, USA (Gannon, Qaseem et al., 2010; Daud, Ramli et al., 2020). Also, diabetes seminars attendance positively affected adherence to treatment guidelines among physicians in Greece. Compared with participants who attended fewer than 2 diabetes conferences/seminars annually, participants who attended from 2 to 5 diabetes conferences/seminars annually exhibited better adherence to treatment guidelines ($p = 0.031$) (Bimpas, Auyeung et al., 2021).

Several previous studies have demonstrated that specialists adhere to clinical guidelines at a higher rate than general practitioners (Pathman, Konrad et al., 1996; Brown, Harris et al., 2002; Kahan, Friedman et al., 2005; Grossman, Silverman et al., 2013). Another research in the United States found that while primary care physicians had similar number of guideline users and non-guideline users, endocrinologists had a higher proportion of guideline users than non-guideline users ($p = 0.01$), and physicians from other subspecialties had a higher proportion of non-guideline users ($p = 0.003$) (Corriere, Minang et al., 2014). Moreover, a previous study in Turkey found that doctors and specialists working in university settings adhered to the guidelines better than doctors and family practitioners working in state organizations (Satman, Imamoglu et al., 2012, Satman, Imamoglu et al., 2012).

Chapter 3: Methodology

3.1 Hypothesis

We hypothesized that physicians' perception of T2D clinical practice guideline's utility impacts their use and adherence to clinical guidelines. Physician characteristics of age, gender, practice region, training level, and board certification are associated with "following guidelines" based on physician perception of guidelines utility (see Figure 1 structural causal model below).

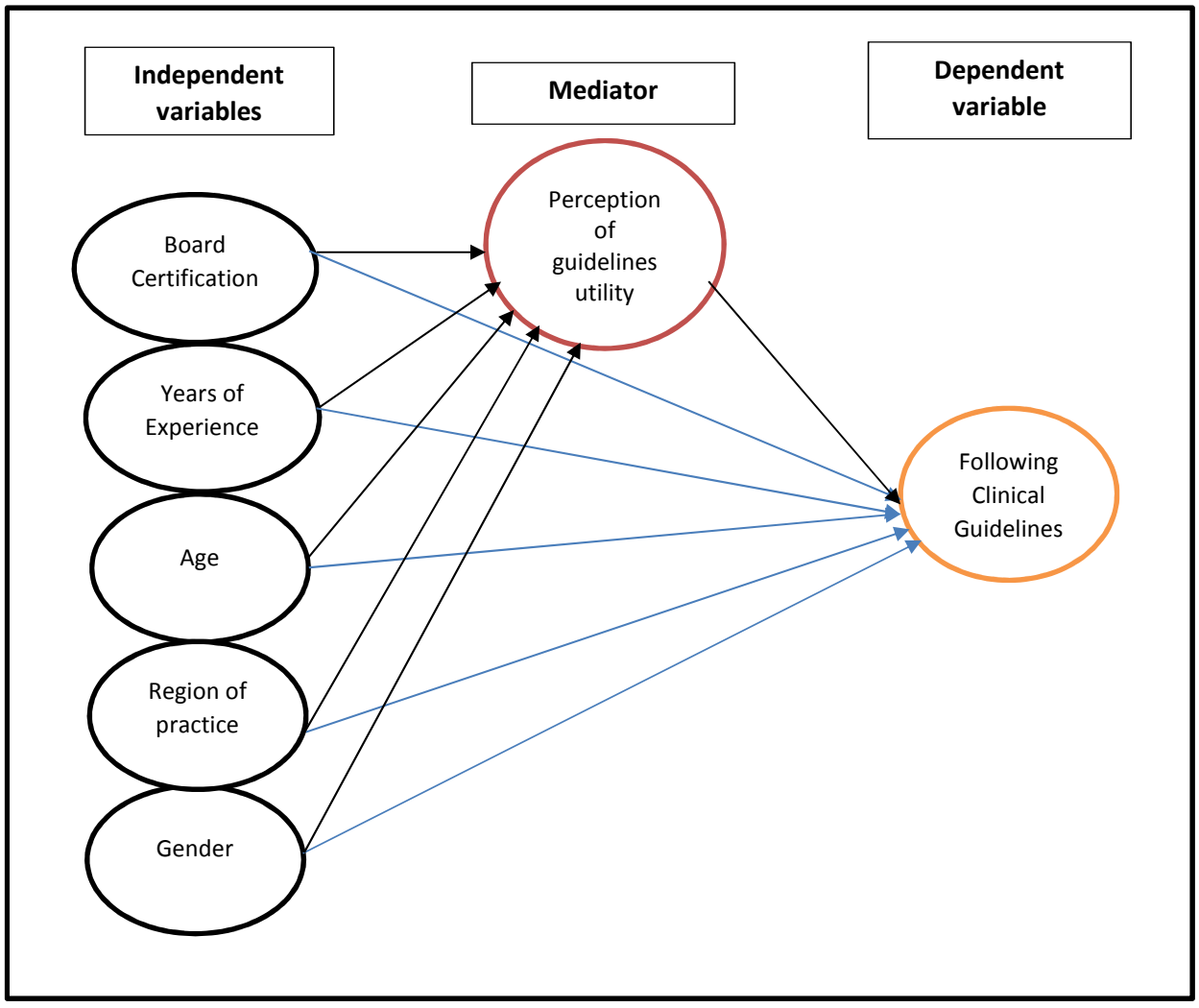

Figure 1: Study structural causal model

* The blue colored arrows highlighting the hypothesized direct association between the independent variables and the dependent variable, and the black colored arrows highlight the indirect association between the independent variables and the dependent variable mediated by the perception of guidelines utility.

3.2 Study Design

This study employed a cross-sectional study design and used a self-administered online survey through Qualtrics software.

3.3 The Survey

The survey (attached in the appendix) consisted of 14 questions divided into four parts. The first part asked about demographics that included gender, age, nationality, board certification, specialty, years of experience, and the region of practice. These questions helped in comparing the perceptions of guidelines utility of different groups of physicians according to these demographics. The second part asked the participants whether they use guidelines to manage their patients who have diabetes mellitus "yes/no format question" (our dependent variable) and required participants to choose which diabetes guidelines they refer to in their practice and have reliable access to. The third part consisted of five questions that utilized a 5-point Likert scale and asked participants about their perception towards the utility of guidelines (strongly agree "given a score of 5", agree, neither agree nor disagree, disagree, and strongly disagree "given a score of 1"). The maximum obtainable total perception score is 25, the higher the score the more positive the perception of the participants about the utility of diabetes clinical guidelines.

The five-point Likert scale covered different aspects of the utility (delivering evidence-based care, patients' satisfaction, decreasing diabetes complications, and efficiency in time and resources in care delivery). The fourth part consisted of one question that asked physicians to choose the available services required for diabetes care in their clinics. This part helped in understanding the availability of services and physicians' adherence to recommended services.

3.4 Sampling

Primary data was collected from healthcare providers in the Saudi Society for Diabetes (SSD) database through a self-administered online survey using Qualtrics software. The survey was distributed through the Saudi Society for Diabetes (SSD), whose membership includes more than five-thousand active physicians from all regions of Saudi Arabia. The SSD forwarded the survey to members and requested them to participate. The survey included a cover letter that described the study and its purpose.

3.5 Data Analysis

The data from this study was analyzed using IBM SPSS version 27 (IBM Corp., Armonk, N.Y., USA). Descriptive statistics were used to describe the characteristics of the study variables as frequency and percentages for the categorical and nominal variables. At the same time, the mean and standard deviation was used to present continuous variables. A Domain was used as the study mediating variable, and it was compared to all indicators. This domain was called "Diabetes Guidelines' Perception Score." The score was calculated by recoding the responses to the following questions:

Following are a couple of statements about the usefulness of the diabetes guidelines.

- Deliver evidence-based care.
- Save time in patient care.
- Contribute to efficient use of resources.
- Increase my patients' satisfaction with care.
- Decrease the risk of diabetes complications.

Answers were recoded as follow:

- Strongly agree = 5
- Agree = 4
- Neither agree nor disagree =3
- Disagree = 2
- Strongly disagree = 1

A Reliability Analysis was used with an Alpha (Cronbach) model to study the properties of measurement scales and the items that compose the scales and the average inter-item correlation. An independent t-test and One-way ANOVA, with Least Significant Difference (LSD) as a post hoc test, respectively, were used to explore the difference in the mean perception score between different demographic groups. These tests were done with the assumption of normal distribution. Also, General Linear Model (GLM) Univariate Analysis was used to identify significant predictors using the Main Effect model. Lastly, a conventional p-value $p<0.05$ was the criteria to reject the null hypothesis. Additionally, we conducted a mediation analysis to explore whether participants' perception about guidelines utility is influencing the relationship between independent variables (demographic and practice characteristics) and our dependent variable (using clinical guideline to manage diabetic patients). Binary logistic regression was used to identify predictors that affect the use of clinical guidelines to manage diabetic patients.

Chapter 4: Results

4.1 Participants Demographics

Out of 5000 questionnaires sent to practicing physicians, 501 were returned at least partially completed. Three were excluded from the analysis because they came from pharmacists. Another five were excluded because not all questions were answered. The final sample subjected to analysis was 493 (response rate 9.9%).

Around half of the study participants (52.5%) were female. Similar percentage of the study participants (50.9%) were aged 45 years and below. More than half of the study participants (55.8%) were non-Saudis, including physicians from Egypt, India, Pakistan, Sudan, Jordan, and Syria. A total of 52.1% of study participants were board-certified. The variations in the number of years of experience of physicians after their degree were relatively small. Most of the respondents (30.5%) had more than 15 years of experience in the medical field after getting a degree, while 19.5% of respondents had less than five years of experience. Similarly, most of the respondents (45.9%) had more than 15 years of experience in the practice of their specialization. Nearly six percent (6%) were practicing their specialization for less than five years. The physicians involved in the study were situated in various regions where they are practicing their specialty. Most of them, constituted by 27.6%, were from the Northern region, while the minority equivalent to 12.8% was from the Eastern region. For further details on the demographic and practice characteristics of the study participants, refer to Table 2.

Table 2: Demographic and practice characteristics of the study participants

Item	Frequency	Percentage
Gender		
Male	234	47.5%
Female	259	52.5%
Age		
25 - 35	108	21.9%
36 - 45	143	29.0%
46 - 55	171	34.7%
over 55	71	11.6%
Nationality		
Saudi	218	44.2%
Non-Saudi	275	55.8%
Board Certification		
Board-certified	257	52.1%
Not board-certified	236	47.9%
Years of experience in medical field after the degree		
Less than 5	46	19.5%
5-10	52	22.0%
11-15	66	28.0%
More than 15	72	30.5%
Years of experience in specialty		
Less than 5	16	6.2%
5-10	52	20.2%
11-15	71	27.6%
More than 15	118	45.9%
Region where specialty is practiced		

Northern region	136	27.6%
Central region	120	24.3%
Western region	68	13.8%
Eastern region	63	12.8%
Southern region	106	21.5%

4.2 Participants Characteristics and their perception about the utility of clinical guidelines

To examine the perception of physicians on the utility of using diabetes guidelines, a set of statements were given to the respondents. Figure 2 shows the average response from the 493 respondents. It reflects that, on average, physicians agreed that diabetes guidelines provide an opportunity to contribute to an efficient use of resources, increases patients' satisfaction with care, saves time in patient care, decreases the risk of diabetes complications, and delivers evidence-based care.

Knowing how physicians in Saudi Arabia perceive the use of diabetes guidelines provides more room to study more about the diabetes guidelines and their overall impact on patients' well-being. This can be done by further analyzing the clinical guidelines through the medical journals they have access to. These include paper journals, journals on the internet, and conferences. Moreover, this can also lead to identifying other sources that can effectively guide physicians and other healthcare providers more suitable for an individual patient with Type 2 Diabetes.

Furthermore, the promising results can lead to broader information dissemination to enhance knowledge and awareness of other physicians and healthcare workers in managing Type 2 Diabetes among their patients.

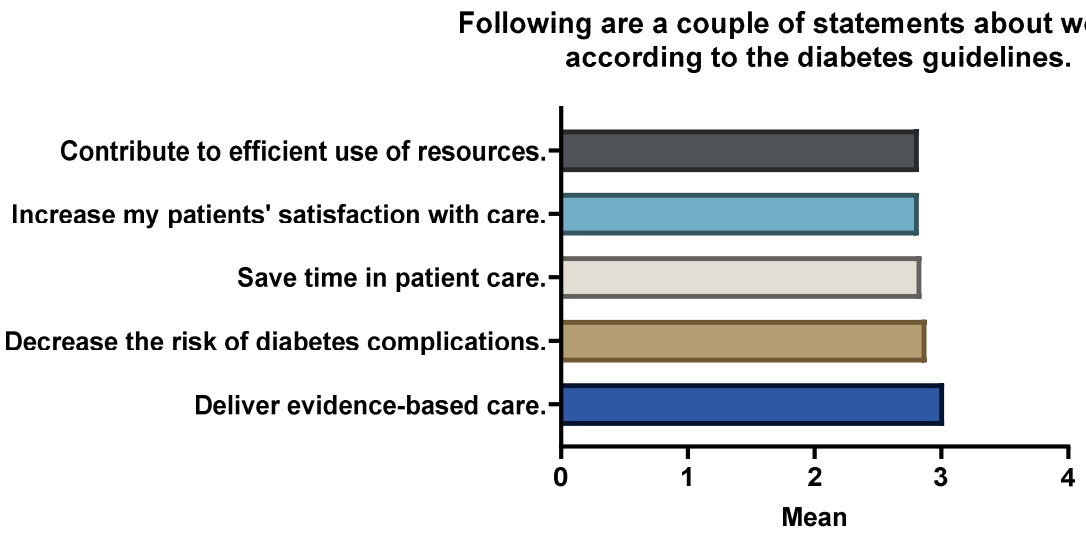

Figure 2. Perception of the respondents on following diabetes guidelines utility

4.2.1 Gender

As shown in Table 3, the responses of both male and female physicians reflect their positive feedback on the utility of clinical guidelines. Approximately 70% agreed that clinical guidelines are useful for managing patients with Type 2 diabetes. There was no significant difference between the perception of male and female physicians regarding the usefulness of using diabetes guidelines as indicated by a p-value greater than 0.05.

4.2.2 Age

Like the observation on the level of perception between male and female physicians, most physicians from different age groups acknowledged the usefulness of diabetes guidelines on managing patients with Type 2 diabetes. The p-value indicates that there was no significant difference between the perception of physicians depending on their age.

4.2.3 Nationality

The participants' response regarding the utility of clinical guidelines on managing people with Type 2 diabetes showed they agreed that using diabetes guidelines, in general, was useful. The results also showed no significant difference in the perception of the utility of clinical guidelines among physicians from Saudi Arabia in comparison to physicians from other countries. This means that perceiving the utility of diabetes guidelines is the same regardless the nationality of attending healthcare workers.

4.2.4 Board certification

Both board-certified physicians and those who were not agreed that clinical guidelines were useful to manage patients with Type 2 diabetes. The results showed there was no significant difference between the perception of board-certified and non-board-certified physicians regarding the utility of diabetes guidelines. Although their responses reflected that they agreed on the usefulness of diabetes guidelines, it can be observed that a relatively smaller mean was derived from the responses of non-board-certified physicians, and those who had board certification were a slightly higher mean.

4.2.5 Years of experience in medical field after the degree

Overall, the physicians' responses, based on their years of experience in the medical field, reflect that they agreed to the usefulness of using diabetes guidelines. Based on the resulting p-value, there was a significant difference among physicians' responses based on their years of experience regarding their perception of the usefulness of utilizing clinical guidelines for managing patients with Type 2 diabetes. Less experienced physicians were more likely to perceive guidelines as useful.

4.2.6 Years of experience in the area of specialization

It can be observed in Table 3 that all physicians except those who had more than 15 years in their area of specialization agreed on the utility derived from using clinical guidelines for patients with Type 2 diabetes. Interestingly, those who had more than 15 years in their area of specialty strongly agreed on the usefulness of diabetes guidelines in the management of patients with Type 2 diabetes. It was also found that there was no significant difference among physicians' responses grouped according to years of experience in their respective specializations. This highlights that years of experience in specialty did not affect physicians' perception of the utility of diabetes guidelines.

4.2.7 Region where specialty is practiced

The perception regarding the usefulness of using clinical guidelines among physicians in different regions was different. Physicians from all regions agreed to a different degree that following the diabetes guidelines is essential for managing patients with Type 2 diabetes. Notably, their responses manifested a significant difference, as indicated by the p-value of less than 0.05. Thus, there is sufficient evidence to say that physicians' response from one region to another is significantly different. Physicians who practice their profession in the Central region had the highest perception score reflecting a more positive perception on the utility of diabetes guidelines compared to others. It is worth mentioning that board certification and years of experience in specialty were borderline significant in terms of their influence on physicians' perception on the utility of diabetes guidelines.

Table 3. Physicians' characteristics and their perception of the utility of diabetes guidelines

Item	Frequency	Percentage	Perception score	*P*-value
Gender				
Male	234	47.5	19.4 ± 3.3	0.450
Female	259	52.5	19.2 ± 2.9	
Total	493	100		
Age				
25 - 35	108	21.9	19.8 ± 3.6	0.159
36 - 45	143	29.0	18.7 ± 3.0	
46 - 55	171	34.7	19.3 ± 3.0	
over 55	71	11.6	19.5 ± 2.5	
Total	493	100		
Nationality				
Saudi	218	44.2	19.5 ± 3.1	0.413
Non-Saudi	275	55.8	19.1 ± 3.1	
Total	493	100		
Board Certification				
Board-certified	257	52.1	19.6 ± 3.1	0.069
Not board-certified	236	47.9	19.0 ± 3.2	
Total	493	100		
Years of experience in medical field after the degree				
Less than 5 years	46	19.5	20.9 ± 2.9	0.001[a]
5-10 years	52	22.0	19.4 ± 3.0	
11-15 years	66	28.0	18.1 ± 3.1	
More than 15 years	72	30.5	18.9 ± 2.9	
Total	493	100		
Years of experience in specialty				

Less than 5 years	16	6.2	19.0 ± 4.3	0.085
5-10 years	52	20.2	18.6 ± 3.5	
11-15 years	71	27.6	19.5 ± 3.3	
More than 15 years	118	45.9	19.9 ± 2.3	
Total	257	100		
Region where specialty is practiced				
Northern region	136	27.6	18.4 ± 3.1	≤0.001[a]
Central region	120	24.3	20.4 ± 2.8	
Western region	68	13.8	18.9 ± 2.8	
Eastern region	63	12.8	17.6 ± 3.9	
Southern region	106	21.5	19.4 ± 3.5	

[a]-significant using One-Way ANOVA test at <0.01 level.

4.3 Medical Specialty

Among the 493 physician respondents, most (28.8%) specialized in internal medicine. The remaining physicians were those with specializations in primary care, family medicine, and endocrinology. Those who chose "other" did not specify their specialty. As can be observed in Table 4, their responses do not relatively vary significantly from one another, implying that physicians from different specializations, in general, have the same perception of the utility of diabetes guidelines.

The p-value indicates there was no significant difference among the responses of physicians in terms of perception of the utility of diabetes guidelines.

4.4 Access to medical journals

Most of the respondents (63.1%) reported that they have attended conferences to stay updated with the clinical guidelines regarding managing patients with Type 2 diabetes. Physicians

relying on the internet corresponded to 51.3% of the total study sample. The remaining were those who consult paper journals (Table 4). As evidenced, there was no significant difference between physicians' responses who consulted paper journals versus using the internet. Those who relied on paper journals and the internet had nearly identical views on the utility of diabetic guidelines. In general, they both thought that following diabetes guidelines was beneficial. Those who were more likely to use journals (print or online) thought clinical guidelines were more useful than those who relied on conferences.

4.5 Services available in clinic

Several services are available in clinics in Saudi Arabia to help manage patients with Type 2 diabetes. A significant difference was found among physicians who conduct specific clinic services for Type 2 diabetes management (Table 4). These services included multidisciplinary care coordination, self-monitoring blood glucose instruction and evaluation, weight-loss counselling, and physical activity instruction, smoking cessation counselling, annual eye examination, diabetes self-management education, and psychological/social status assessments.

4.6 Provider of the medical services

Most respondents mentioned that nurses (62.9%) commonly provided such services, followed by physicians (46.2%) (Table 4). There was no statistically significant difference in the mean perception score between different healthcare providers.

Table 3: Medical information of physicians and their perception score on the utility of diabetes guidelines

Variables	Frequency	Percentage	Perception Score	*P*-value
Specialty				
Primary Care Physician	93	18.9	19.6 ± 3.3	0.157

Family Medicine	137	27.8	18.8 ± 3.0	
Internal Medicine	142	28.8	18.7 ± 3.1	
Endocrinology	90	18.3	19.5 ± 3.0	
Others	54	11.0	20.7 ± 3.1	
Access to medical journals to stay updated with the guidelines				
Paper Journals	219	44.4	20.1 ± 2.7	
Internet	253	51.3	19.9 ± 3.4	
Conferences	311	63.1	19.2 ± 2.9	0.318
Services available in clinic				
Multidisciplinary care coordination	148	30.0	20.1 ± 2.7	0.417
Self-monitoring blood glucose instruction and evaluation	144	29.2	19.7 ± 2.6	
Intensive insulin therapy instruction	130	26.4	19.4 ± 3.0	
Weight-loss counselling and physical activity instruction	98	19.9	18.5 ± 3.1	
Medical nutrition therapy	90	18.3	19.1 ± 3.1	
Smoking-cessation counselling	62	12.6	18.0 ± 3.0	
Self-care of the feet education	75	15.2	19.0 ± 2.8	
Annual eye examination	78	15.8	18.2 ± 3.0	
Diabetes self-management education	46	9.3	17.6 ± 3.4	
Psychological/social status assessments	113	22.9	19.7 ± 2.6	
Who provides the services				
Physicians	228	46.2	19.8 ± 2.9	
Diabetes Educators	95	19.3	19.6 ± 3.2	
Nurses	310	62.9	19.3 ± 2.7	0.453

Social workers	140	28.4	19.6 ± 3.4
Others	139	28.2	20.1 ± 3.4

[b]-significant using Welch's *t*-test at <0.05 level.

4.7 Participation in DPP and DSME

Thirty-five percent of the respondents shared that their clinic provided both a Diabetes Prevention Program (DPP) and Diabetes Self-Management Education Program (DSME). A total of 26.0% of the respondents disclosed that their clinic was involved only in DSME, while another 26% mentioned that their clinic did not participate in either. The minority, or 12% of total respondents, said their clinic was involved in DPP only (Table 5). As can be noticed in Table 5, those who shared that their clinics were participating in DPP had a relatively higher mean of diabetes guidelines' perception score. However, this difference did not reach the significance level, as indicated by the p-value. It is worth mentioning that the DPP and DSME are programs promulgated by the U.S. CDC.

4.8 Usage of guidelines

A slight majority of respondents (58.6%) shared that they are following diabetes guidelines (Table 3). Notably, there was a significant difference in physicians' responses regarding their perception of the utility of diabetes guidelines. Those who followed the guidelines had a higher diabetes guidelines' perception score.

4.9 Guidelines used to manage diabetes

The largest number of respondents (46%) indicated that they utilize the European Association for the Study of Diabetes (EASD) guidelines in managing diabetes, while 30.4% use the International Diabetes Federation (IDF) Guidelines, and 20.8% follow the American Diabetes Association (ADA) Guidelines (Table 5). A significant difference was seen in physicians'

responses regarding their perception of the utility of diabetes guidelines. Remarkably, those who followed ADA Guidelines had higher perceptions of guidelines' utility. As indicated by the diabetes guideline score, other respondents showed that they agreed to the utility of following clinical guidelines.

Table 4: Utilization of guidelines in managing diabetes

Item	Count	Percent	Perception score	*P*-value
Clinic participation in Diabetes Prevention Program (DPP) or/and Diabetes Self-Management Education program (DSME)[e]				
DPP only	59	12.0	19.5 ± 2.9	0.118
DSME only	128	26.0	18.7 ± 3.3	
DPP and DSME	174	35.4	19.5 ± 2.8	
None	131	26.6	19.5 ± 3.4	
Usage of guidelines to manage diabetes				
Used guidelines	289	58.6	19.7 ± 2.9	<0.001[a]
Did not use guidelines	204	41.4	18.6 ± 3.4	
Guidelines used to manage diabetes [d]				
American Diabetes Association (ADA) Guidelines	60	20.8	21.1 ± 2.6	≤0.001
International Diabetes Federation (IDF) Guidelines	88	30.4	18.9 ± 3.1	
European Association for the Study of Diabetes (EASD) Guidelines	133	46.0	19.6 ± 2.6	
Other	8	2.8	20.3 ± 2.5	

[a]-significant using Welch's *t*-test at <0.05 level.

4.10 Physicians Guidelines Utility Perception and Adherence to Clinical Guidelines

The following tables show the results of fitting a multivariate model with covariates significant at the 0.25 level in the univariable analysis. Hosmer et al., (2013) asserted that the use of a p-value less than 0.25 portrays clinical importance. Moreover, they used the work of Bendel and Afifi in 1977 on linear regression and by Mickey and Greenland in 1989 about logistic regression for applying 0.20 or 0.25 level of significance as a criterion in appropriate initial variable selection. Hosmer et al., (2013) also mentioned that the use of a more traditional level-the use of a 0.05 level of significance "often fails to identify variables known to be important".

Given these circumstances for using p-value of 0.25, Table 6 presents multiple linear regression analysis for those physicians who reported "following guidelines" in managing diabetes where the dependent variable was the physician's perception score and the independent variables were physicians'' characteristics that significantly affected physicians' perception scores (Board Certification, years of experience in specialty, region where physicians practice, and the availability of DPP and DSME programs). Results indicate that having five to ten years of experience in practicing specialty significantly attributed to physicians' perception of Type 2 diabetes guidelines utility. As indicated by the negative coefficient, this denotes that within the five to ten years of experience, a one-year less increment of experience could result in a relatively higher score on the usefulness of such guidelines. Hence, this implies that those who had relatively lower years of experience within five to ten years were more likely to adhere to guidelines.

The participation of clinics in the Diabetes Prevention Program (DPP) and the Diabetes Self-Management Education Program (DSME) did not significantly affect the perception towards diabetes guidelines utility. Both portrayed a negative coefficient, meaning physicians would perceive guidelines with a higher utility when a clinic does not participate in either of the two.

When all these variables (board certification, years of experience in specialty, region of practice, and participation in DPP and/or DSME) are equal to zero, the diabetes guideline perception score, as indicated by the value of the intercept, will be 93.899. This implies that physicians strongly agree to the usefulness of the diabetes guidelines and reflected in their adherence to the clinical guidelines.

Table 5: Linear regression analysis showing the relationship between physicians' characteristics and perceptions guideline utility and guideline adherence

Parameter Estimates [a]		
Dependent Variable: Perception of diabetes guidelines utility	**B**	**p-value**
R square: 0.152		
Intercept	93.899	<0.001
Board-certified = Yes	0[b]	
Years of experience in your specialty =Less than 5 years	-4.161	0.355
Years of experience in your specialty =5 – 10 years	-7.396	0.005
Years of experience in your specialty=11 – 15 years	-0.311	0.892
Region where the physician practices = Northern region	-5.090	0.063
Region where the physician practices = Central region	2.162	0.435
Region where the physician practices = Western region	0.729	0.831
Region where the physician practices = Eastern region	-4.773	0.139
Participation of clinic in Diabetes Prevention Program (DPP) or/and Diabetes Self-Management Education Program (DSME)=DPP only	-16.923	0.102
Participation of clinic in Diabetes Prevention Program (DPP) or/and Diabetes Self-Management Education program (DSME)=DSME only	-18.174	0.075
Participation of clinic in Diabetes Prevention Program (DPP) or/and Diabetes Self-Management Education program (DSME)=DPP and DSME	-11.308	0.267

[a]-Do you use guidelines to manage diabetes? = Yes

[b]-This parameter is set to zero because it is redundant.

Tables 7 presents multiple linear regression analysis for those physicians who reported "not following guidelines" in managing diabetes where the dependent variable was the physician's perception score and the independent variables were physicians'' characteristics that significantly affected physicians' perception scores (Board Certification, years of experience in specialty, region where physicians practice, and the availability of DPP and DSME programs) The years of experience in the specialty and region where they practiced described the view of the utility of guidelines linked to the high chance of non-adherence to guidelines. Those who had experience of fewer than five years in their specialty were significantly related to having a better perception of the diabetes guidelines utility, as denoted by the positive coefficient. However, it was also reported that they were also more likely to not adhere to diabetes guidelines.

When all these variables (board certification, years of experience in specialty, region of practice, and participation in DPP and/or DSME) are equal to zero, the diabetes guideline score, as indicated by the value of the intercept, will be 68.077, implying that the respondents somewhat agreed that the guidelines were useful.

Table 7: Linear regression analysis showing the relationship between physicians' characteristics and perception on guidelines utility and being non-adherent

Parameter Estimates [a]		
Dependent Variable: Perception of diabetes guidelines utility	**B**	**p-value**
R Square: 0.166		
Intercept	68.077	<0.001
Board-certified = Yes	0b	
Years of experience in your specialty =Less than 5 years	19.493	0.011

Years of experience in your specialty =5 – 10 years	7.569	0.492
Years of experience in your specialty=11 – 15 years	-3.013	0.746
Region where the physician practices = Northern region	-16.779	0.088
Region where the physician practices = Central region	-5.228	0.606
Region where the physician practices = Western region	-7.327	0.514
Region where the physician practices = Eastern region	0.274	0.990
Participation of clinic in Diabetes Prevention Program (DPP) or/and Diabetes Self-Management Education program (DSME)=DPP only	-7.146	0.568
Participation of clinic in Diabetes Prevention Program (DPP) or/and Diabetes Self-Management Education program (DSME)=DSME only	-5.920	0.580
Participation of clinic in Diabetes Prevention Program (DPP) or/and Diabetes Self-Management Education program (DSME)=DPP and DSME	4.103	0.660

[a]-Do you use guidelines to manage diabetes? = No

[b]-This parameter is set to zero because it is redundant.

Table 8 presents a multiple linear regression analysis for those physicians who reported "following guidelines" in managing diabetes where the dependent variable was the physician's perception score and the independent variables were medical-related information that significantly affected physicians' perception scores (access to medical journals, services provided in clinic, and who provide these services). The use of paper journals to stay updated with the clinical guidelines was found to be positively and significantly related to the perception of the utility of clinical guidelines. This leads to a high likelihood of following guidelines in managing patients with Type 2 diabetes.

The availability of services provided in the clinics was observed to be significantly related to the perception of the utility of diabetes guidelines. As the negative coefficients imply, the

unavailability of such services (weight-loss, smoking-cessation, diabetes self-management education, and psychological/social status assessments) creates a positive leaning on the perception of the usefulness of clinical guidelines. This leads them to be more likely to adhere to clinical guidelines. This can imply a need to improve such services in order to manage patients with diabetes more efficiently.

It is also notable that when physicians provide these services, the respondents shared a better perception of the usefulness of diabetes guidelines. This, in turn, is reflected in a high likelihood of adherence to diabetes guidelines.

When all these variables are equal to zero, the diabetes guidelines' perception score, as indicated by the value of the intercept, will be 71.185. This denotes that the respondents lean more on the perception that the diabetes guidelines are useful and, thus, it is worthy of being followed or utilized.

Table 8: Linear regression analysis showing the effect of medical-related information of respondents and perception of diabetes guidelines that affect adherence to guidelines

Parameter Estimates [a] **Dependent Variable: Perception of diabetes guidelines utility**	**B**	***P*-value**
R Square: 0.099		
Intercept	71.185	<0.001
Access to medical journals to stay updated with the guidelines=Paper Journals	5.387	0.002
Access to medical journals to stay updated with the guidelines?=Internet	3.082	0.063
Services provided in clinic=Multidisciplinary care coordination	0.662	0.739
Services provided in clinic =Self-monitoring blood glucose instruction and evaluation	-3.180	0.075

Services provided in clinic = Weight-loss counselling and physical activity instruction	-7.969	<0.001
Services provided in clinic = Smoking-cessation counselling	-5.684	0.041
Which services do you provide in your clinic?=Annual eye examination	-3.564	0.160
Services provided in clinic=Diabetes self-management education	-5.878	0.043
Services provided in clinic = Psychological/social status assessments	-4.768	0.016
Personnel who provides these services=Physicians	6.742	0.001
Personnel who provides these services =Diabetes Educators	2.772	0.151

[a]-Do you use guidelines to manage diabetes? = Yes

Table 9 presents multiple linear regression analysis for those physicians who reported "not following guidelines" in managing diabetes where the dependent variable was the physician's perception score and the independent variables were medical-related information that significantly affected physicians' perception scores (access to medical journals, services provided in clinic, and who provide these services). As can be seen, the use of the internet for accessing medical journals is statistically and positively related to the perception of diabetes guidelines utility. However, this perception from this source of information leads to a higher likelihood of not adhering to guidelines. This can denote that perhaps physicians need to evaluate sources accessed on the internet which can affect their perception of the utility of guidelines.

Moreover, clinics that provide Diabetes Self-Management Education (DSME) tended to have a lower score on the perception of diabetes guidelines utility. This creates a higher likelihood of not adhering to the clinical guidelines. This can imply room for improvement and reassessment of such a program in a way that can help both the physicians and the patients.

When physicians were the ones who provided these recommended services, this created a positive impact on the perception of diabetes guidelines score. However, the likelihood of not adhering to guidelines was high.

Table 9: Linear regression analysis showing the effect of medical-related information of respondents and perception of diabetes guidelines that affect non-adherence to guidelines

Parameter Estimates [a] **Dependent Variable: Perception of diabetes guidelines utility**	**B**	***P*-value**
R Square: 0.055		
Intercept	64.384	<0.001
Access to medical journals to stay updated with the guidelines=Paper Journals	-0.434	0.888
Access to medical journals to stay updated with the guidelines?=Internet	7.768	0.005
Services provided in clinic=Multidisciplinary care coordination	1.077	0.791
Services provided in clinic =Self-monitoring blood glucose instruction and evaluation	6.658	0.108
Services provided in clinic = Weight-loss counselling and physical activity instruction	1.513	0.670
Services provided in clinic = Smoking-cessation counselling	-2.103	0.571
Which services do you provide in your clinic?=Annual eye examination	-2.920	0.398
Services provided in clinic=Diabetes self-management education	-10.480	0.020
Services provided in clinic = Psychological/social status assessments	5.976	0.218
Personnel who provides these services=Physicians	6.742	0.001
Personnel who provides these services =Diabetes Educators	2.772	0.151

[a]-Do you use guidelines to manage diabetes? = No

When we conducted multiple linear regression analysis for those physicians who reported "following guidelines" in managing diabetes where the dependent variable was the physician's

perception score and the independent variables were all variable related to physicians' practices characteristics (age, gender, region of practice, years of experience after getting the degree, years of experience in specialty, Clinic participation in Diabetes Prevention Program (DPP) or/and Diabetes Self-Management Education program (DSME), board certification, access to medical journals, and service availability) to explore the relationship between physicians' characteristics and perceptions guideline utility and guideline adherence the R-square become 0.231 and being board certified, participation of clinic in Diabetes Prevention Program (DPP) or/and Diabetes Self-Management Education program (DSME)=DSME only, practicing in the Northern and Eastern regions, being aged (36 – 55 years), and having practice experience more than five years were significant variables that affected guidelines adherence.

When we conducted multiple linear regression analysis for those physicians who reported "not following guidelines" in managing diabetes where the dependent variable was the physician's perception score and the independent variables all variable related to physicians' practices characteristics (age, gender, region of practice, years of experience after getting the degree, years of experience in specialty, Clinic participation in Diabetes Prevention Program (DPP) or/and Diabetes Self-Management Education program (DSME), board certification, and service availability) to explore the relationship between physicians' characteristics and perceptions guideline utility and guideline non-adherence the R-square become 0.210, and having experience 5-10 years was significant variable that affected guidelines non-adherence.

4.11 Physicians guidelines utility perception as a mediator for clinical guidelines adherence

Binary logistic regression analysis where the dependent variable was (following guidelines? Yes/No) and the independent variables were (gender, age, nationality, board

certification, years of experience after medical degree, years of experience in specialty, Region where physicians practice, and the availability of DPP and DSME) identified that physicians who are over 55 years of age and those who reported having over 5 years of experience in specialty were more likely to use clinical guidelines to manage Type 2 diabetes patients ($p \leq 0.01$). On the other hand, non-Saudi physicians and those who were not board-certified were less likely to use clinical guidelines to manage Type 2 diabetes patients compared to others ($p \leq 0.01$). Also, it showed that those physicians who participate in DSME were more likely to follow guidelines ($p \leq 0.001$), and the same for those who participate in DPP and DSME ($p \leq 0.001$) (Table 10).

In order to explore the role of physicians' perception (as a mediating variable) on the utilization of clinical guidelines to manage Type 2 diabetes patients, a mediation analysis (Model 4) was conducted. Physicians' perception was placed as a mediator and physicians' demographic and practice characteristics were placed as independent variables, and the utilization of clinical guidelines to manage Type 2 diabetes patients was placed as the dependent variable.

Mediation analysis indicated that physicians' perception of guideline utility showed a negative mediation effect for the age group 36-45 years and those who reported duration of experience of 11-15 years after obtaining their degree on their utilization of clinical guidelines to manage Type 2 diabetes patients. At the same time, physicians' perception showed a positive mediation effect for those who reported a duration of experience in the specialty of 15 years and above. Also, physicians' perception showed a positive mediation effect for those who practice in the Northern Region, while physicians' perception showed a negative mediation effect for those who practice in the Eastern Region. Moreover, physicians' perception showed a negative mediation effect for those who participate in DSME only (Table 10).

Table 10: Binary logistic regression analysis and mediation analysis

Item	Odds ratio of using clinical guidelines to manage patients	P-value	Mediation effect of perception on odds ratio of using clinical guidelines	Boot LLCI – Boot ULCI
Gender				
Male (Reference group)	1.00			
Female	1.32 (0.92-1.90)	0.126	No mediation effect	-0.0240 to 0.7857
Age (years)				
25 – 35 years (Reference group)	1.00			
36 – 45 years	0.87 (0.59-1.28)	0.477	There is a mediation effect	-0.0875 (-0.1960 to -0.0100)
46 – 55 years	1.23 (0.84-1.80)	0.281	No mediation effect	- 0.0752 to 0.0754
over 55 years	2.31 (1.31-4.1)	0.004**	No mediation effect	- 0.0495 to 0.1488
Nationality				
Saudi (Reference group)	1.00			
Non-Saudi	0.85 (0.81-0.90)	≤0.001***	No mediation effect	-0.0186 to 0.0027
Board Certification				
Board-certified (Reference group)	1.00			
Not board-certified	0.05 (0.03-0.08)	≤0.001***	No mediation effect	-0.1747 to 0.0079
Years of experience in medical field after the degree (years)				

Less than 5 years (Reference group)	1.00			
5-10 years	0.14 (0.07-0.28)	≤0.001 ***	No mediation effect	- 0.1194 to 0.1563
11-15 years	0.20 (0.11-0.35)	≤0.001 ***	There is a mediation effect	- 0.1297 (-0.2873 to -0.0221)
More than 15 years	0.47 (0.29-0.79)	0.004**	No mediation effect	- 0.2154 to 0.0060
Years of experience in specialty (years)				
Less than 5 (Reference group)	1.00			
5-10 years	5.17 (2.28-11.71)	≤0.001 ***	No mediation effect	- 0.2587 to 0.0388
11-15 years	5.17 (2.58-10.36)	≤0.001 ***	No mediation effect	- 0.0851 to 0.1411
More than 15 years	11.51 (5.84-22.69)	≤0.001 ***	There is a mediation effect	0.0921 (0.0128 to 0.1998)
Region where specialty is practiced				
Region where the physician practices = Northern region (Reference group)	1.00			
Region where the physician practices = Northern region	0.94 (0.39-2.26)	0.882	There is a mediation effect	0.3026 (0.1121 to 0.5603)
Region where the physician practices = Central region	0.75 (0.34-1.68)	0.486	No mediation effect	0.0068 (-0.1438 to 0.1606)
Region where the physician practices = Western region	0.55 (0.21-1.42)	0.217	No mediation effect	0.1337 (-0.0250 to 0.3528)
Region where the physician practices = Eastern region	0.59 (0.32-1.08)	0.084	There is a mediation effect	-0.1951 (-0.4046 to -0.0440)
Clinic participation in Diabetes Prevention Program (DPP) or/and Diabetes Self-Management Education program (DSME)				

Participation of clinic in Diabetes Prevention Program (DPP) or/and Diabetes Self-Management Education program (DSME)=DPP only (Reference group)	1.00			
Participation of clinic in Diabetes Prevention Program (DPP) or/and Diabetes Self-Management Education program (DSME)=DSME only	3.71 (2.31-5.98)	≤0.001 ***	There is a mediation effect	-0.1247 (-0.2581 to -0.0212)
Participation of clinic in Diabetes Prevention Program (DPP) or/and Diabetes Self-Management Education program (DSME)=DPP and DSME	3.37 (2.23-5.09)	≤0.001 ***	No mediation effect	0.0404 (-0.0240 to 0.1297)

Chapter 5: Discussion

5.1 Discussion

The aim of this research was to assess physicians' perception of the utility of clinical guidelines in the management of people with Type 2 diabetes in Saudi Arabia. The key findings of this research are: 1) physicians' perception about the utility of clinical guidelines significantly differed based on years of experience after obtaining their degree, the region of practice, utilization of clinical guidelines to manage their patients, and the types of clinical guidelines used to manage Type 2 diabetes patients; 2) having five to ten years of experience in practicing specialty negatively affect physicians' perception towards the utility of clinical guidelines; 3) physicians who are aged over 55 years and those who reported having years of experience in specialty over 5 years were more likely to use clinical guidelines to manage Type 2 diabetes patients ($p \leq 0.01$); and 4) physicians' perception showed a negative mediation effect for the age group 36-45 years and those who reported duration of experience of 11-15 years after obtaining their degree on their utilization of clinical guidelines to manage Type 2 diabetes patients. At the same time, physicians' perception showed a positive mediation effect for those who reported duration of experience in the specialty of 15 years and above.

In our study, both male and female physicians expressed positive feedback on the utility of clinical guidelines, with no gender-based variations in how useful they thought they were. Approximately 70% showed they agree that clinical guidelines are useful for managing patients with Type 2 diabetes. There was no significant difference between the perception of male and female physicians regarding the usefulness of using diabetes guidelines. This was aligned with the findings of a previous study by Somily et al., which reported no significant difference between adherence of males and females to diabetes guidelines (Somily, 2017). On the other hand, a cross-

sectional study done by Berthold et al., suggests that female physicians provide better quality care for diabetic patients than their male counterparts primarily because female physicians tend to use a more participative style of decision-making which is a fundamental component in the diabetes care (Berthold, 2008). Similarly, there was no significant difference in physicians' perception based on their age. Two studies are incongruent with the result of this study. Somily et al., observed less adherence to Diabetes Guidelines among physicians less than thirty years old (Somily, 2017). Meanwhile, Mehta et al., found that more senior physicians in the USA (age group 35-44 years and 45-55 years) were less likely to report using the United States Preventive Services Taskforce guidelines compared to younger physicians (25-44 years age group) (Mehta, Mocarski et al., 2017). Despite that, there is a need for improving the utilization of clinical guidelines on managing diabetes patients regardless of the physician's age. On the other hand, there was a significant difference in physicians' perceptions based on their years of experience. This can indicate that they have varying levels of perspective regarding medical care towards diabetes patients using the prescribed clinical guidelines. In addition, it paves the way for harnessing the knowledge and skill of healthcare workers regarding the utilization of diabetes guidelines specifically for senior physicians. Confirming the findings of our study, Somily et al., reported a low level of adherence to diabetes guidelines among physicians with less experience in the primary health care practice (Somily, 2017). On the other hand, this result was different from a study conducted by Brenner et al. (2020). According to their research, physicians in the USA who have more than ten years of experience with Type 2 diabetes patients were much less likely to adhere to diabetes guidelines (Brenner, 2020).

In our study, there was no statistically significant difference in physicians' perception based on their years of experience in their respective specialization. This can imply that a vast

medical experience in practicing respective specializations is not necessarily associated with a better comprehensive understanding of the utility of the guidelines that one can get from utilizing diabetes guidelines.

Physicians' nationality also did not affect their perception of the utility of clinical guidelines. This was different from the findings of a previous study in Saudi Arabia which concluded that Saudi physicians were less adherent to diabetes guidelines, which justified that non-Saudi physicians may be subjected to stricter employment qualifications (Somily, 2017).

Medical specialty did not affect physicians' perception about the utility of clinical guidelines and all participating physicians reported similar responses that did not differ significantly. This can provide a positive insight that physicians, despite differences in specializations, can perceive using diabetes guidelines as good, leading to harnessing their medical strength.

Being a board-certified physician did not significantly affect physicians' perception about the utility of clinical guidelines. A slightly higher perception score could reflect that board-certified physicians are more convinced that using diabetes guidelines is useful for patients. These insights indicate a call for physicians in Saudi Arabia to put more focus on achieving board certification. This way more physicians can expand their knowledge in terms of utilizing diabetes guidelines in the management of patients with Type 2 diabetes. Another important factor that affected physicians' perception about the utility of clinical guidelines was the region of practice. In our study, we found that physicians' response from one region to another is significantly different. This could be attributed to the fact of having different managerial procedures followed by senior physicians and healthcare managers which could be affected by their clinical and practice backgrounds (Alkhiari, Alzayer et al., 2018). At the same time, there are multiple confounding

factors that could have influenced these findings such as the distribution of physicians at different regions in Saudi Arabia based on their experience and qualifications which could possibly be inconsistent. Amer et al., in their study reported that the context or health care setting at the institution where evidence-based medicine and CPGs are part of the undergraduate and postgraduate medical school curricula, was one of the most important contributing factors that positively affect physician perception (Amer, Nemri et al., 2019). They also reported that engagement in continual quality improvement projects and efforts as a result of national and international accreditation activities is another important factor that improved physician perception and adherence to clinical guidelines (Amer, Nemri et al., 2019). Additionally, previous literature stressed the necessity for enhancing continuous medical education among medical practitioners and potential training in the treatment and management of diabetes (Corriere, Minang et al., 2014).

Several services are available at clinics in Saudi Arabia to help manage patients with Type 2 diabetes. A significant difference was found among physicians who conduct specific clinic services for Type 2 diabetes management. This means that responses can significantly vary depending on the availability of such services in their respective clinics.

Clinic participation in Diabetes Prevention Program (DPP) and Diabetes Self-Management Education Program (DSME) did not significantly affect the perception of physicians in our study. Despite this, participating in both DPD and DSME can lead to a higher level of understanding and better perception of the utility of diabetes guidelines to manage people with Type 2 diabetes. This can imply a need to validate or reassess the efficiency of DPP and DSME and whether clinics needed to employ another program/s that can help manage patients with diabetes type 2. On the other hand, those who followed the guidelines had a higher diabetes guidelines' perception score, which implies that those who followed guidelines strongly agreed that following clinical

guidelines was of utter importance in managing patients with Type 2 diabetes. In addition to this, even the type of guidelines used was another important factor that affected physicians' perception score and those who used ADA showed higher perception scores relative to others. Wahabi et al., reported that certain circumstances improve health care providers' use and adherence to CPGs, such as when the guideline's source is a credible and respected body or organization, when there is consensus about the benefit to patients, and when supplies for implementation, such as medicine and equipment, are available (Wahabi, Alzeidan et al., 2011). Physicians' judgments of DPP/DSME utility, as well as utility perceptions following clinic resources, may well play a role in clinic adoption of those approaches.

According to our study findings, having five to ten years of experience in practicing specialty was negatively affecting physicians' perception towards the utility of clinical guidelines. This was confirming the findings of a previous study that was conducted in Canada. The authors reported that compliance level to clinical guidelines was better with more clinical seniority and training (Alkhiari, Alzayer et al., 2018). This calls for a need to strengthen more research on the utility of guidelines in managing patients with Type 2 diabetes to build more confidence among physicians in managing their patients. Another important study finding was that those who had experience of fewer than five years in their specialty were more likely to not adhere to diabetes guidelines. This can imply that physicians with less than five years of specialty need to be more aware and equipped for applying clinical guidelines in managing patients with Type 2 diabetes. Clinics must pursue more activities or programs for physicians with less than five years of medical experience in order to gain a broader perspective that may result in better perception, thus leading to adherence to the guidelines.

Physician perception concerning the utility of clinical guidelines has influenced the relationship between physicians' demographic and practice characteristics and their adherence to clinical guidelines. Some of our most important philosophers have long recognized that perception (or the activation of a perceptual representation) can lead to equivalent overt behavior. The assumption behind this concept is that, in addition to perceptual or cognitive representations (e.g., attributes, stereotypes), behaviors are also cognitively represented, and that these perceptual and behavioral representations are somehow intertwined. Percepts and acts are perfectly matched and continuous. Both percepts and acts relate to events having similar characteristics. The main difference is that percepts correspond to ongoing, actor-independent events, whereas acts refer to to-be-generated, actor-dependent events (Dijksterhuis, 1998). It is also worth mentioning that there are many unknown factors that could affect physicians' adherence to guidelines. This might include promotional efforts directed towards healthcare professionals by pharmaceutical companies. The cost might also be another factor that affects physicians' adherence to clinical guidelines as some patients might demonstrate cost-related non-adherence (Naser 2021; Ali, Naser et al., 2022).

5.2 Policy Implications

Although the results showed there is no difference between Saudi and non-Saudi physicians regarding the perception of the utility of diabetes guidelines, there is an opportunity for improvement that include:

- Restructuring Board-Certification Programs by incorporating clinical and non-clinical sessions that discuss the importance and benefits of using guidelines when treating patients with type 2 diabetes to improve both patients' outcomes and the quality of provided healthcare services. (EBM)

- Facilitating the dissemination of knowledge and Evidence-Based Medicine (EBM) by providing easy and reliable access to medical journals and improving the quality and quantity of symposiums and workshops focusing on treating type 2 diabetes.
- Encouraging physicians to attend these sessions, symposiums, and workshops by rewarding them with academic hours as each physician must attend a required number of academic hours to renew their medical license.

For non-Saudi physicians, the Ministry of Health in Saudi Arabia should improve the standards that qualify non-Saudi physicians to practice in Saudi Arabia. Furthermore, the healthcare system in Saudi Arabia faces a massive shortage in the number of Saudi physicians, making the need for highly skilled and knowledgeable physicians a must as they represent more than 50% of the workforce in the medical field. In addition, these physicians would help disseminate the knowledge and skills required not only in treating diabetes but also in all other medical specialties.

Regarding the availability of services, the results showed that several services were available across all regions of Saudi Arabia. On the other hand, the results also showed a considerable opportunity for improvement in service availability. One of the solutions would be increasing the number of diabetes centers that offer all the required healthcare services for patients with Type 2 diabetes. There are a few diabetes centers in Saudi Arabia right now, but they are located in only 3-4 major cities. There should be at least one diabetes center in each major city of all regions of Saudi Arabia because these services are critical to implementing diabetes guidelines, improving diabetes outcomes and patient satisfaction.

Regarding the availability of the Diabetes Prevention Program (DPP) and Diabetes Self-Management Education Program (DSME), the recommendation for service availability also

applies here. DPP and DSME are important as they help mitigate the burden of diabetes spending by decreasing the incidence of diabetes by identifying the population at high risk and intervening to stop their progress to diabetes, which results in decreased spending on related services and complications.

This research has multiple strong points. First, the study population included physicians from all specialty with no restrictions. Physicians from all regions in the Kingdom were included. The relatively large sample size increases the generalizability of the study findings. It is also worth mentioning that in this research the logistic regression analysis applied the 0.20 or 0.25 level of significance as a criterion in appropriate initial variable selection, which was recommended by previous literature as standards for "clinical" and scientific criteria. This increases the reliability of the variable identified from the regression analysis in this research.

At the same time, there were also limitations to this research. Due to the small sample size for each sub-group, this research was unable to distinguish from the data the percentages for each type of service by profession (physicians, nurses, etc.). Therefore, the findings of this research should be interpreted carefully. The cross-sectional nature of the study design might also have affected the ability of this research to explore causality. Desirability bias is expected from participants, and rather than responding truly, they choose to answer questions about how their comments will be understood by others. Respondents will select either socially acceptable or politically correct replies.

5.3 Opportunities for Future Research

There are findings in this study that highlight opportunities for future research that must be addressed. In this study, we assessed physicians' perception of the utility of diabetes guidelines, and, in general, it was positive. To see the whole picture, we must study the effect of

this positive perception on the outcomes for patients regarding the management of diabetes. Also, it would help to find other gaps in achieving the best care for patients with Type 2 diabetes. In addition, we should study the effect of this positive perception on the prevalence of diabetes because all diabetes guidelines from different international diabetes associations include recommendations for prevention and early detection of pre-diabetes that allow for intervention before progressing to diabetes.

Also, the results showed physicians who followed American Diabetes Association (ADA) guidelines had a higher perception score than physicians who followed other guidelines. On the other hand, the European Association for the Study of Diabetes (EASD) guidelines were the most followed guidelines in Saudi Arabia. For a country with a high prevalence rate of diabetes, such as Saudi Arabia, there should be a Saudi guideline for managing diabetes as treating diabetes was a challenge since the early stages of developing the health care system. Another option would be the adoption of one of the already published guidelines to be followed throughout Saudi Arabia. This will lead to an important research question "Which guideline has the best outcome for the patients?". From the results of this study, three main guidelines were followed: European Association for the Study of Diabetes (EASD) guidelines were followed by 46% of physicians, 30.4% followed the International Diabetes Federation (IDF) Guidelines, and 20.8% followed the American Diabetes Association (ADA) Guidelines. This diversity would be an advantage in answering this question since we can study the outcome of each guideline.

Also, the results showed the availability of services recommended by guidelines is low. Furthermore, we should study whether these services are provided by the government for free or by the private section since these services are necessary for the ideal management of diabetes and would be an additional burden on patients in the absence of medical insurance which would

raise an issue of accessibility. Another important finding related to the availability of services is that only 9% of physicians provided diabetes self-management education to their patients. This is critical for patients as they must be able to make decisions to either increase or decrease the dose for certain situations such as low or high blood glucose levels.

Also, the results showed physicians who practice at clinics participating in Diabetes Prevention Program (DPP) and/or Diabetes Self-Management Education Program (DSME) had a lower perception score. One explanation for these results could be the way these programs were applied was demanding in effort and time. We should investigate these programs and how they were applied resulting in unexpected perceptions since these programs are recommended by diabetes guidelines.

5.4 Conclusion

In general, physicians' perception of the utility of diabetes guidelines is positive. This is a good sign to achieve optimum care for patients with Type 2 diabetes. Nevertheless, there are other parts of the healthcare system that should be investigated and improved. These parts include the government, which owns and governs most hospitals in Saudi Arabia, healthcare centers (hospitals and primary healthcare centers), and patients. The government should upgrade the healthcare system's infrastructure to acquire new changes required for achieving optimum care. Healthcare centers should prepare the environment and facilitate the implementation of guidelines. Patients should also be compliant with physicians' recommendations as without patients' compliance nothing could be achieved. If all these parts work together for improvement, optimum care will be achievable.

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