Natural Resources for Human Health
eISSN: 2583-1194

Original Research

Received 15 March 2026
Revised 24 April 2026
Accepted 20 May 2026

Natural Resources for Human Health 2026, Vol. 6 (1s): 281–299

KEYWORDS:
Type 2 diabetes mellitus; primary healthcare; Saudi Arabia; glycemic control; clinical inertia; patient adherence; diabetes complications

Primary Care Management of Type 2 Diabetes Mellitus in Saudi Arabia: A Systematic Review of Clinical Outcomes and Healthcare Challenges

Najlaa Mohammad Alsudairy[1], Ohud Musaad Alshamrani[2], Sumaiyah Saeed Khan[3], Ohoud Hassan Balkhair[4], Afnan Hamza Abdullah Ageel[5], Areej Mohammedali Munshi[6], Hateem Abdullatif Alzaharini[7], Fahad Ali Mahnashi[8], Alanazey Mohammed Amer M[9], Fuad Hussain ALnakhli[10], Amjad Abdullah Alkhawaji[11].

[1]Family Medicine/ Diabetes Management Consultant. Specialized Polyclinic, Primary Health Care, National Guard Hospital, Western Region. Najlaa.Alsudairy@gmail.com
[2]Staff Nurse SN1. Specialized Polyclinic, Primary Health Care, National Guard Hospital, Western Region. do.di4u@hotmail.com
[3]Consultant Family Medicine. National Guard Primary Health Care Clinic at Al Sharayea Makkah, National Guard Hospital, Western Region. Khansu1@ngha.med.sa
[4]Consultant Family Medicine. Specialized Polyclinic, Primary Health Care, National Guard Hospital, Western Region. Balkhairoh@hotmail.com
[5]Consultant Family Medicine. National Guard Primary Health Care Clinic at Al Sharayea Makkah, National Guard Hospital, Western Region. ageelaf@ngha.med.sa
[6]Consultant Family Medicine. National Guard Primary Health Care Clinic at Al Sharayea Makkah, National Guard Hospital, Western Region. mounshiam@ngha.med.sa
[7]Family Medicine - Senior Registrar. Presidency of State Security. hatemzahrani2@gmail.com
[8]Family Medicine - Senior Registrar. Presidency of State Security. Dr.mahnashi@hotmail.com
[9]Preventive Medicine Physician. Northern Borders Health Cluster. moha-stc-12@hotmail.com
[10]Nursing Technician. MOH. fo20fo2014@gmail.com
[11]Family Medicine Resident. Primary Healthcare Center of Dhubbat Neighborhood - Najran, Saudi Arabia. Dr_amjadabdullah@yahoo.com

ABSTRACT:

Background: Type 2 diabetes mellitus (T2DM) represents a major public health challenge in Saudi Arabia, with prevalence rates among the highest globally (23.1% age-standardized) and only 22.5% of patients achieving adequate glycemic control (HbA1c <7%). Primary healthcare centers serve as the cornerstone of diabetes management in the Kingdom, yet significant gaps persist in translating available resources into optimal clinical outcomes.

Natural Resources for Human Health
eISSN: 2583-1194

Objective: This systematic review synthesizes evidence on clinical outcomes and healthcare challenges associated with primary care management of T2DM in Saudi Arabia, identifying barriers to optimal care and effective interventional strategies.

Methods: A comprehensive systematic search was conducted across PubMed/MEDLINE, Scopus, Web of Science, and Google Scholar for studies published between 2021-2026. Following PRISMA 2020 guidelines, 24 studies met eligibility criteria and were included. Quality assessment utilized JBI checklists, Newcastle-Ottawa Scale, and Cochrane RoB 2. Due to substantial heterogeneity, a narrative synthesis was performed.

Results: Glycemic control remains persistently suboptimal, with mean HbA1c levels ranging from 7.69% to 10.47% and only 15.7-22.5% achieving HbA1c <7%. Microvascular complications affected 55.1% of patients (nephropathy 80.2%, retinopathy 32.7%, neuropathy 8.4%), with cardiovascular disease prevalence at 18%. Patient-level barriers included low medication adherence (46.7%), poor lifestyle modification adherence, and significant knowledge gaps. Clinical inertia was prevalent, with only 48% of family physicians aware of therapeutic inertia and 31.6% unfamiliar with the concept. System-level barriers included lack of multidisciplinary teams (68.5%), time constraints (53.5%), and high workload (52.0%). Promising interventions—patient activation-tailored programs, hybrid telemedicine models, and health coaching—demonstrated significant HbA1c reductions (2.59% mean reduction).

Conclusion: Primary care T2DM management in Saudi Arabia is suboptimal due to multifaceted barriers at patient, physician, and system levels. Multi-level evidence-based strategies, including provider education, team-based care, patient activation, and digital health integration, are urgently needed to improve outcomes and achieve Saudi Vision 2030 health objectives.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) has emerged as one of the most pressing public health challenges of the twenty-first century, imposing a substantial and growing burden on healthcare systems worldwide. According to the International Diabetes Federation (IDF), approximately 537 million adults aged 20–79 years were living with diabetes in 2021, with this number projected to reach 643 million by 2030 and 783 million by 2045 [1]. Over 90% of these cases are type 2 diabetes, and notably, three in four adults with diabetes reside in low- and middle-income countries. The Global Burden of Disease Study 2021 reported that global diabetes prevalence has more than doubled over the past three decades, with type 2 diabetes accounting for the vast majority of cases and contributing significantly to mortality and disability-adjusted life years worldwide [2]. By 2023, global diabetes deaths had already exceeded 2.0 million per year, surpassing the 2030 upper forecast bound of 1.91 million—a sobering indication that the epidemic is accelerating faster than previously anticipated. This escalating burden is driven by multiple interrelated factors, including population aging, urbanization, rising obesity rates, physical inactivity, and unhealthy dietary patterns, all of which have contributed to the relentless rise in T2DM incidence across all regions of the world [1, 2].

The Kingdom of Saudi Arabia bears a disproportionately heavy burden of T2DM, with prevalence rates that rank among the highest globally. The IDF estimates that Saudi Arabia has an age-standardized diabetes prevalence of 23.1% among adults aged 20–79 years, placing the Kingdom among the top ten countries worldwide with the highest prevalence of diabetes [3]. Data from the IDF Diabetes Atlas indicate that the number of adults living with diabetes in Saudi Arabia has grown dramatically from approximately 996,700 in 2000 to 5.3 million in 2024, and this figure is projected to reach 9.5 million by 2050 [3]. A comprehensive analysis of the Global Burden of Disease Study data from 1990 to 2023 revealed a substantial increase in age-standardized prevalence of diabetes in Saudi Arabia (+117.3%) and incidence (+97.2%), with T2DM accounting for the majority of this burden and demonstrating a marked male predominance [4]. The national pooled prevalence of T2DM among the general adult population in Saudi Arabia has been estimated at 16.4% (95% CI: 11.6–17.5), while the pooled prevalence of prediabetes stands at 24.1% (95% CI: 19.5–29.4%) [5]. A recent cross-sectional analysis involving over 14,000 participants from

48 primary healthcare centers in Riyadh found that 12.4% of Saudi residents were diabetic, with older age (≥75 years: AOR 6.30), male gender (AOR 1.33), obesity (AOR 1.39), unemployment (AOR 1.49), hypertension (AOR 10.42), and high cholesterol (AOR 3.13) identified as significant independent risk factors [6]. Other studies have reported even higher estimates, with some suggesting that T2DM affects nearly a quarter of the Saudi population. This epidemiological transition reflects the rapid socioeconomic and demographic changes that Saudi Arabia has undergone over the past decades, including urbanization, adoption of Westernized dietary patterns, and increasingly sedentary lifestyles [3, 5].

Despite the high prevalence of T2DM in Saudi Arabia, glycemic control remains persistently suboptimal, with serious implications for patient outcomes and healthcare resource utilization. Only 22.5% of Saudi diabetic individuals maintain adequate glycemic control as defined by hemoglobin A1c (HbA1c) levels below 7% [3]. A study conducted across 15 primary care centers in Madinah involving 692 patients with T2DM reported a mean HbA1c of 8.39 ± 1.7%, with glycemic goals achieved in only 15.7% of patients [6]. This pattern of inadequate metabolic control has been consistently documented across multiple regions of the Kingdom, with a study from Jazan showing that the proportion of controlled diabetes cases fluctuated around 42–44% between 2021 and 2023. The consequences of poor glycemic control are profound, as T2DM is a major risk factor for a wide range of microvascular and macrovascular complications. Among Saudi patients with T2DM attending primary care settings, dyslipidemia has been identified as the most prevalent complication, affecting 42.3% of patients, followed by retinopathy (13.4%), neuropathy (30%), and cardiovascular diseases (20%) [4]. A comparative study of urban and rural Saudi populations found that 2.6% of T2DM patients had a history of heart disease, 6.08% had experienced cerebrovascular events, 44.34% reported limb numbness, 47.82% experienced vision complications, and 10.43% had renal impairment [5]. These alarming figures underscore the urgent need for effective, evidence-based strategies to improve diabetes management and prevent complications at the primary care level.

Primary healthcare centers serve as the cornerstone of diabetes care in Saudi Arabia, providing the first point of contact for the majority of T2DM patients and playing a pivotal role in screening, diagnosis, ongoing management, and prevention of complications [6]. The Kingdom's healthcare system has made substantial investments in strengthening primary care infrastructure, with a network of over 2,000 primary healthcare centers distributed across all regions, offering free medications and comprehensive services to Saudi citizens. However, despite this considerable investment, significant challenges persist in translating available resources into optimal clinical outcomes. The primary care management of T2DM in Saudi Arabia is confronted with a complex array of barriers operating at multiple levels. At the patient level, studies have documented low medication adherence (with rates as low as 46.7%), poor adherence to lifestyle modifications, substantial knowledge gaps regarding diabetes and its complications, and widespread use of complementary and alternative medicine without physician consultation [5, 6]. At the physician level, clinical inertia—the failure to initiate or intensify therapy when treatment goals are not met—has emerged as a major impediment, with research indicating that many Saudi family physicians lack awareness of the concept of therapeutic inertia and face barriers to treatment intensification including lack of support staff (48.7%), concerns over patient adherence (47.6%), and insufficient knowledge of new treatment options (45.9%) [4]. System-level barriers further compound these challenges, including a lack of multidisciplinary teams (68.5%), time constraints (53.5%), high workload (52.0%), and uneven distribution of resources [6]. These multifaceted challenges highlight the need for a comprehensive synthesis of the evidence to identify effective strategies for improving diabetes outcomes in primary care settings.

Despite the growing body of research on T2DM management in Saudi Arabia, there remains a significant gap in the literature regarding the systematic synthesis of evidence on clinical outcomes and healthcare challenges specifically within primary care settings. While individual studies have examined various aspects of diabetes care—ranging from glycemic control and complication rates to patient knowledge, physician practices, and innovative interventions—no comprehensive systematic review has integrated this evidence to provide a holistic understanding of the current state of primary care diabetes management in the Kingdom [1–6]. This systematic review aims to synthesize the available evidence on the clinical outcomes and healthcare challenges associated with primary care management of type 2 diabetes mellitus in Saudi Arabia.

METHODOLOGY

The review was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines.

Search Strategy

A comprehensive and systematic literature search was conducted across four major electronic databases: PubMed/MEDLINE, Scopus, Web of Science, and Google Scholar. The search was restricted to publications over the last five years, covering the period from 2021 to 2026, to capture the most contemporary evidence reflecting current clinical practices and healthcare challenges in Saudi Arabia. The search strategy employed a combination of Medical Subject Headings (MeSH) and free-text terms grouped into three core concepts: (1) T2DM (e.g., "type 2 diabetes mellitus", "T2DM", "non-insulin-dependent diabetes"), (2) primary care (e.g., "primary health care", "primary care", "family medicine", "PHC"), and (3) Saudi Arabia (e.g., "Saudi Arabia", "Kingdom of Saudi Arabia", "KSA"). Additional terms related to clinical outcomes (e.g., "glycemic control", "HbA1c", "complications", "cardiovascular", "nephropathy", "retinopathy") and healthcare challenges (e.g., "adherence", "clinical inertia", "awareness", "knowledge", "barriers", "telehealth") were combined using Boolean operators (AND/OR). The search was limited to studies published in English and those involving human participants. Reference lists of the included articles and relevant reviews were also hand-searched to identify any additional eligible studies.

Eligibility Criteria

Studies were considered eligible for inclusion if they met the following predefined criteria based on the PICOS framework: (a) **Population**: adults (≥18 years) diagnosed with T2DM or primary care physicians managing T2DM patients; (b) **Intervention/Exposure**: management practices, interventions, or care models delivered in primary care settings; (c) **Comparison**: not mandatory but applicable in comparative studies; (d) **Outcomes**: clinical outcomes (such as HbA1c levels, blood pressure, lipid profile, prevalence of microvascular and macrovascular complications, neurocognitive function, and health-related quality of life) or healthcare challenges (including patient adherence, knowledge, awareness, physician prescribing patterns, clinical inertia, and system-level barriers); and (e) **Setting**: primary healthcare centers (PHCCs), family medicine clinics, or other designated primary care facilities within Saudi Arabia. Studies were excluded if they were: review articles, editorials, conference abstracts, protocols without primary outcome data, or letters; conducted exclusively in secondary or tertiary care settings without primary care components; focused on type 1 diabetes, prediabetes prevention (without management outcomes), or gestational diabetes; or not available in English.

Study Selection and Data Extraction

All identified records were imported into the Rayyan intelligent systematic review platform (Rayyan Systems Inc., Cambridge, MA, USA) for efficient screening and collaboration. Following the removal of duplicate records, two independent reviewers screened the titles and abstracts against the eligibility criteria. Potentially relevant full-text articles were then retrieved and assessed for eligibility in a second round of screening. Disagreements between the reviewers at any stage were resolved through consensus discussion or by consultation with a third senior reviewer. From an initial pool of retrieved records, 45 studies were selected for full-text eligibility assessment, of which 24 studies ultimately met the inclusion criteria and were incorporated into the final synthesis. Data extraction was performed independently by two reviewers using a standardized, pre-piloted data extraction form developed in Microsoft Excel. Extracted data items included: author(s), publication year, study location, study design, sample size and characteristics, primary and secondary outcome measures, key findings related to clinical outcomes and healthcare challenges, and details of any interventions evaluated. Any discrepancies in data extraction were resolved through consensus.

Risk of Bias and Quality Assessment

The methodological quality and risk of bias of the included studies were assessed using validated tools specifically tailored to the study designs. For the 14 cross-sectional studies, the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross-Sectional Studies was applied, evaluating criteria such as clear definition of inclusion criteria, detailed description of subjects and setting, valid and reliable measurement of exposure and outcomes, identification and management of confounding factors, and appropriate statistical analysis. For the five retrospective cohort studies, the Newcastle-Ottawa Scale (NOS) was utilized, assessing selection, comparability, and outcome assessment domains. The two pre-post interventional studies were evaluated using the JBI Checklist for Quasi-Experimental Studies, which examines clear cause-and-effect relationships, comparability of participants, appropriate measurement of outcomes, and adequacy of follow-up. The single mixed-methods randomized controlled feasibility trial was assessed using the Cochrane Risk of Bias Tool for Randomized Trials (RoB 2), focusing on randomization process, deviations from intended interventions, missing outcome data, measurement of outcomes, and selection of reported results.

Natural Resources for Human Health
eISSN: 2583-1194

Data Synthesis

Due to substantial heterogeneity in study designs, populations, settings, and outcome measures across the 24 included studies, a meta-analysis was not feasible. Instead, a narrative synthesis was performed. Data were organized thematically into two main domains: (1) clinical outcomes (including glycemic control, complication rates, health-related quality of life, and other physiological measures) and (2) healthcare challenges (encompassing patient-level factors such as knowledge, adherence, and awareness; physician-level factors such as clinical inertia and prescribing patterns; and system-level barriers). Findings were summarized in tabular format (Tables 1 and 2) to facilitate clear presentation and comparison across studies. The narrative synthesis integrated the evidence to highlight consistent patterns, contrasts, and implications for clinical practice and policy in Saudi Arabia.

RESULTS:

PRISMA flow diagram illustrates the systematic study selection process for this review. A total of 289 records were initially identified through database searches, of which 156 duplicate records were removed prior to screening. The remaining 133 records underwent title and abstract screening, resulting in the exclusion of 71 records that did not meet the eligibility criteria. Subsequently, 62 reports were sought for retrieval, but 24 could not be retrieved, leaving 38 reports for full-text eligibility assessment. Of these, 14 reports were excluded: 11 due to wrong outcomes, 2 due to wrong population, and 1 was an abstract without sufficient data. Ultimately, 24 studies met all inclusion criteria and were included in the final systematic review.

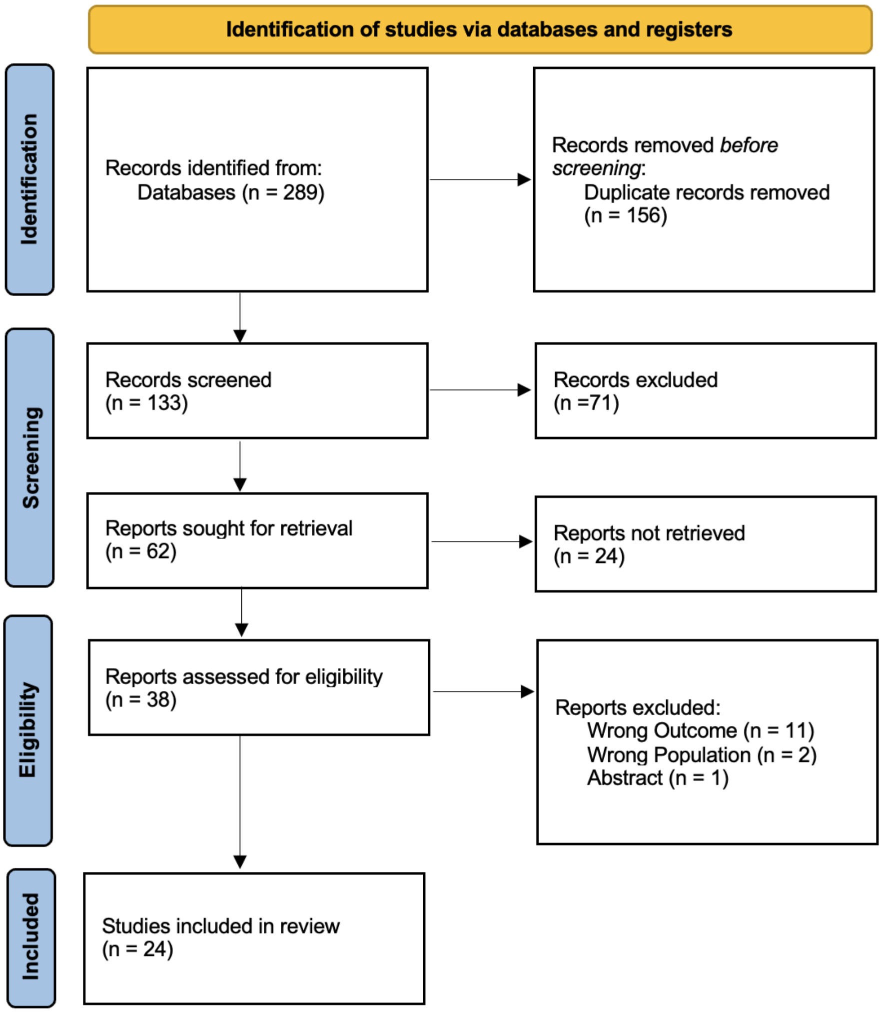

Figure (1): PRISMA Flow Diagram

Table 1 summarizes the methodological frameworks and demographic profiles of the 24 eligible studies. The majority adopted cross-sectional designs (n=14), such as those by Alshaikh et al. [7], Alsaleh et al. [9], and Homady et al. [16], while retrospective cohort designs were utilized in five studies, including Alsaidan et al. [8] and Hussein et al. [17]. Interventional and quasi-experimental studies accounted for four investigations, most notably the pre-post study by Almutairi N et al. [12] and the hybrid telemedicine model by Tourkmani et al. [21]. Sample sizes ranged considerably, from the 30-participant feasibility trial by Almulhim et al. [22] to the 988-patient retrospective analysis by Sharahili et al. [14], with the majority recruiting between 200 and 420 participants. Geographically, the studies were well distributed across Saudi Arabia, with a concentration in Riyadh (n=8) and the Eastern Province (n=3), alongside national multicenter studies such as the CAPTURE sub-study by Alguwaihes et al. [15]. The study populations predominantly comprised middle-aged to older adults, with mean ages between 49.7 and 60.3 years, and a consistent trend toward female predominance, although some investigations, such as those by Almutairi N et al. [19] and Karim et al. [23], reported balanced or male-majority samples. Additionally, several studies specifically targeted primary care physicians rather than patients, evaluating their knowledge and prescribing practices [20, 25, 26, 28].

Table 2 synthesizes the primary clinical outcomes reported across the included investigations, with glycemic control emerging as the central measure. Suboptimal HbA1c levels were consistently documented; for instance, Almutairi N et al. [19] reported a mean HbA1c of 8.4% with 74.5% of patients uncontrolled, while Innab et al. [29] found a mean of 8.23% and Albasheer et al. [30] noted that only 19.9% achieved HbA1c <7%. Interventional strategies demonstrated significant promise: the patient activation-tailored intervention by Almutairi N et al. [12] reduced HbA1c from 8.38% to 7.55%, the hybrid in-person/telemedicine model by Tourkmani et al. [21] achieved a reduction from 10.47% to 7.87%, and semaglutide therapy in a primary care setting by Alzahrani et al. [24] lowered HbA1c from 8.2% to 6.9% when combined with lifestyle modifications. The prevalence of diabetes-related complications was substantial; Alsaidan et al. [8] reported an 11.2% incidence of cardiovascular disease and 10.4% nephropathy, while Alnaim et al. [18] found a 55.1% prevalence of microvascular complications, with nephropathy being the most common (80.2%). Furthermore, Karim et al. [23] demonstrated that a diabetes duration of ≥5 years significantly increased the risk of chronic kidney disease (2.1-fold), coronary artery disease (3.2-fold), and hypertension (6.2-fold). Neurocognitive dysfunction was identified in 35.2% of patients by Alshaikh et al. [7], and health-related quality of life, as assessed by Homady et al. [16], was consistently lower among females, older adults, and those with longer disease duration or comorbid hypertension.

Findings also highlights a wide array of healthcare challenges and barriers at the patient, physician, and system levels. At the patient level, Alfulayw et al. [10] reported that only 46.7% of participants were adherent to their medications, with forgetfulness, lack of knowledge, and medication side effects cited as primary reasons, and adherence to lifestyle modifications was described as "low and unsatisfactory." Awareness gaps were prevalent; Albadrani et al. [13] found that 10.8% had poor knowledge of diabetic retinopathy, and Alarfaj et al. [11] reported that while insulin injection practices were generally good, knowledge scores were significantly influenced by gender, education, and previous hypoglycemic episodes. At the physician level, clinical inertia represented a major barrier. Surrati et al. [26] found that only 48% of family physicians were aware of the concept of therapeutic inertia, and Alfadhly et al. [28] reported that 31.6% were unfamiliar with the term "clinical inertia," with lack of support staff (48.7%) and concern over patient adherence (47.6%) being the most frequent barriers to treatment intensification. Furthermore, AlSofiani et al. [20] revealed that cost was a major consideration preventing the prescription of GLP-1 receptor agonists (75% of specialists, 65% of generalists) and SGLT-2 inhibitors, aligning with Alguwaihes et al. [15] who found that only 23.6% of patients received glucose-lowering agents with proven cardiovascular benefit. System-level barriers, including lack of multidisciplinary teams (68.5%) and time constraints (53.5%), were identified by Surrati et al. [26], while Aman Allah et al. [27] demonstrated that telehealth was non-inferior to in-person care, offering a viable solution to overcome some of these systemic limitations.

Table 3 provides a comprehensive risk of bias assessment for all included studies, utilizing design-specific, validated tools to ensure methodological transparency. The overall quality of the evidence base is sufficient to inform clinical practice and policy, with the pre-post and feasibility studies providing valuable preliminary data for future large-scale randomized controlled trials.

Table 1. Methodological and Demographic Characteristics of Included Studies

Study (Author, Year [Ref])	Location / Setting	Study Design	Sample Size (N)	Sample Characteristics (Age, Sex, etc.)	Primary Care Setting Details
Alshaikh et al., 2021 [7]	Jeddah (5 PHCCs)	Cross-sectional	236	Mean age 60.3±9.5 yrs; 61.0% female; DM duration 14.1±8.4 yrs	Primary Health Care Centers (PHCCs)
Alsaidan et al., 2021 [8]	Riyadh (Family Medicine Clinics, KFSH&RC)	Retrospective cohort	365	Mean Dx age 50±11.3 yrs; 52.9% female; follow-up 7.1±3.9 yrs	Family medicine clinics (tertiary hospital-based primary care)
Alsaleh et al., 2022 [9]	Abha (PHC)	Cross-sectional (survey)	381	36% had DM ≤5 yrs; mixed genders	Primary healthcare centers, Abha
Alfulayw et al., 2022 [10]	Eastern Province	Cross-sectional (online survey)	426	Mixed demographics; various age groups	PHCCs (governmental) – social media recruitment
Alarfaj et al., 2023 [11]	Riyadh (PHC)	Cross-sectional	324	≤59 yrs (57%); 56.3% female	Primary healthcare center, Riyadh
Almutairi N et al., 2023 [12]	Saudi Arabia (multiple PHCs)	Pre-post interventional	82	Mean age 51.3±9.9 yrs; 61% female	Primary healthcare centers (nationwide)
Albadrani et al., 2023 [13]	Madinah (PHCs)	Cross-sectional	240	Median age 49.7 yrs; 50.4% male	Primary healthcare centers, Madinah
Sharahili et al., 2023 [14]	Jeddah (Prince Abdul Majeed HC)	Retrospective cross-sectional	988	42.9% aged 55–64 yrs; 53.3% male	Primary healthcare center (PAMHC)
Alguwaihes et al., 2023 [15]	7 sites (Taif, Riyadh, Jeddah, Al Ahsa, Buraidah)	Cross-sectional (CAPTURE sub-study)	883	Adults ≥18 yrs; 566 from primary care	Primary & secondary care centers
Homady et al., 2023 [16]	Samtah Town, southern Saudi Arabia	Cross-sectional	420	Mixed age groups; both sexes	Primary healthcare centers
Hussein et al., 2023 [17]	Riyadh (Family Medicine Clinics, KFSH&RC)	Retrospective cohort	352	40–75 yrs; 74.15% Saudi; 51.99% female	Family medicine clinics (tertiary hospital-based)
Alnaim et al., 2023 [18]	Eastern Province (NGHA hospitals)	Retrospective cross-sectional	935	54.1% female; mean HbA1c 8.04%	Diabetes clinics in primary care (National Guard)

Almutairi N et al., 2024 [19]	Saudi Arabia (PHCs)	Cross-sectional	398	Mean age 53.2±10.7 yrs; 54.9% male; mean HbA1c 8.4%	Primary care centers (national)
AlSofiani et al., 2024 [20]	Saudi Arabia	Web-based cross-sectional (physicians)	135 physicians	Specialists (endocrinologists) & generalists (family/primary care)	Primary & secondary care physicians
Tourkmani et al., 2024 [21]	Riyadh (3 chronic illness centers, PSMMC)	Prospective multicenter pre-post	181	Mean age 58.6±11.2 yrs; 56.9% female; DM duration 13.8±8.5 yrs	Family medicine/PHC chronic illness centers
Almulhim et al., 2024 [22]	Saudi Arabia	Mixed-methods RCT (feasibility)	30	Adults with uncontrolled T2DM (HbA1c ≥7); literate in Arabic	Primary care settings
Karim et al., 2025 [23]	Riyadh (1 public hospital, 1 PHC, 1 private facility)	Cross-sectional observational	248	Mixed; T2DM duration ≥5 yrs associated with higher comorbidities	Public PHC clinic + secondary/private
Alzahrani et al., 2025 [24]	Jeddah (KAMC primary care clinic)	Retrospective cohort	238	Adults on semaglutide ≥6 months; mean baseline HbA1c 8.2%	Primary healthcare clinic (KAMC)
Aljulajil et al., 2025 [25]	Qassim Region	Cross-sectional (physicians)	161 PHC physicians	Public sector primary care physicians	Primary care centers, Qassim
Surrati et al., 2025 [26]	Madinah	Cross-sectional (physicians)	200 family physicians	39% aged 41–50 yrs; 52.5% male; 45% GPs, 51.5% specialists/consultants	Primary care centers
Aman Allah et al., 2025 [27]	Taif (multiple PHCs)	Retrospective case-control cohort	243 (118 telehealth, 125 in-person)	T2D patients managed at PHCs	Primary healthcare centers (PHCs), Taif
Alfadhly et al., 2026 [28]	Al Taif city	Cross-sectional (physicians)	264 family physicians	Family physicians working at PHC centers	Primary care centers, Al Taif
Innab et al., 2026 [29]	Riyadh (capital city PHCs)	Cross-sectional	134	Adults with T2DM; mean HbA1c 8.23; mixed sexes	Primary care centers (capital city)
Albasheer et al., 2026 [30]	Jazan (PHCs)	Cross-sectional	336	Adults with T2DM; 55.7% physically inactive; mixed genders	Primary healthcare centers, Jazan

Table 2. Clinical Outcomes, Management Challenges, and Key Findings

Study (Author, Year [Ref])	Primary Domain / Focus	Main Outcome Measures	Key Findings / Conclusions
Alshaikh et al., 2021 [7]	Neurocognitive dysfunction (NCD)	MMSE score; glycemic control; lifestyle factors	NCD prevalence 35.2%. Independent risk factors: female sex, low education, longer DM duration, older age at Dx, poor glycemic control, sedentary lifestyle.
Alsaidan et al., 2021 [8]	Incidence of CVD and nephropathy	HbA1c; time to developing CVD/nephropathy	CVD incidence 11.2%, nephropathy 10.4%. Mean time to first complication 5.5 yrs. HbA1c was not significantly different between those with/without complications.
Alsaleh et al., 2022 [9]	Awareness of diabetic retinopathy (DR)	Knowledge, attitude, and practice regarding eye exams	93.5% knew diabetes affects eyes; 63.3% agreed regular exams are necessary. 57% thought no eye visit needed if controlled. Better awareness with longer DM duration.
Alfulayw et al., 2022 [10]	Noncompliance with medications and lifestyle	Adherence rates; contributing factors	46.7% adherent to meds. Low adherence to diet/exercise. Top factors: forgetfulness, lack of knowledge, side effects, diet difficulty. Age, marital status, occupation, comorbidities, DM duration, complications were significantly associated with adherence.
Alarfaj et al., 2023 [11]	Knowledge and practice of insulin therapy	Knowledge score (0–10); injection practices	Mean knowledge score 6.5 (satisfactory). 92.5% rotated sites; 95.7% took insulin regularly. Knowledge influenced by gender, education, educator visits, hypoglycemia episodes. Better knowledge linked to better practice.
Almutairi N et al., 2023 [12]	Patient activation tailored intervention	HbA1c, BMI, SDSCA, DKT, PAM, PAID, DQOL	Significant improvements: HbA1c (8.38→7.55), BMI (30.90→29.16), PAM score (54.74→61.58), SDSCA diet/exercise/BG testing, and DKT. Supports tailored activation interventions.
Albadrani et al., 2023 [13]	Awareness of DR in Madinah	Knowledge level (poor/fair/good)	42.1% good, 47.1% fair, 10.8% poor knowledge. Higher education, longer DM duration, and regular eye exams correlated with better knowledge. Physicians were the primary information source.
Sharahili et al., 2023 [14]	HbA1c correlation with lipid profile	HbA1c, TC, TG, HDL, LDL, BP	HbA1c positively correlated with TC and TG. Males had lower mean cholesterol, BMI, HbA1c, HDL, LDL compared to females, but higher TG and DBP. Highlights link between glycemic control and dyslipidemia.

Alguwaihes et al., 2023 [15]	CVD prevalence (CAPTURE Saudi)	Established CVD, ASCVD, medication use	Weighted CVD prevalence 18%; ASCVD 15.1% (82.4% of CVD). Coronary heart disease most common (13.4%). Only 23.6% used glucose-lowering agents with proven CV benefit. Lower than global prevalence, possibly due to documentation gaps.
Homady et al., 2023 [16]	Health-related quality of life (HRQOL)	WHOQOL-BREF; DASS; HbA1c	Female sex, age >50, lower education, longer DM duration, complications, and comorbid HTN were associated with lower HRQOL. Combined hypoglycemic/insulin therapy with diet/exercise improved physical HRQOL.
Hussein et al., 2023 [17]	Continuity of care (COC) impact	HbA1c, LDL, BP, preventive screenings	90.34% had high UPCS; 64.2% high COCi. COC did NOT significantly improve health indicators (HbA1c, LDL, BP) or preventive screening completion. First such report in Saudi/Middle East.
Alnaim et al., 2023 [18]	Microvascular complications	Retinopathy, nephropathy, neuropathy screening	Microvascular complications prevalence 55.1% (nephropathy 80.2%, retinopathy 32.7%, neuropathy 8.4%). Higher age, ophthalmology visits, and injection therapy were predictive factors. Mean HbA1c was 8.04%.
Almutairi N et al., 2024 [19]	Patient activation and self-management	PAM, SDSCA, HbA1c	Mean PAM score 55.9. Higher activation levels associated with better glycemic control, diet, physical activity, BG self-testing, foot care, and smoking. Not with medication adherence. Suggests activation-informed interventions are promising.
AlSofiani et al., 2024 [20]	Factors influencing GLP-1 RA / SGLT-2i choice	Prescribing patterns; cost considerations	Sulfonylurea still most common second-line (50%). Cost was a major barrier for GLP-1 RA (75% specialists, 65% generalists) and SGLT-2i (57% specialists, 71% generalists). Significant specialty-based differences in prescribing drivers.
Tourkmani et al., 2024 [21]	Hybrid in-person/telemedicine model	HbA1c reduction	HbA1c significantly reduced from 10.47% to 7.87% (mean reduction 2.59%, p<0.001). Supports hybrid models for uncontrolled T2DM in primary care, reducing in-person visits while improving control.
Almulhim et al., 2024 [22]	Health coaching feasibility	Recruitment/retention; HbA1c, BMI, WC, self-efficacy	High eligibility (90%), recruitment (79%), retention (97%). Notable improvements in HbA1c, BMI, WC, self-efficacy, and diabetes self-care in the coaching group. Participants reported high satisfaction. Supports larger RCT.

Karim et al., 2025 [23]	Cardiovascular and renal comorbidities	CKD, CAD, CHF, cerebrovascular disease, HTN	DM duration ≥5 yrs increased risk of CKD (2.1x), CAD (3.2x), cerebrovascular (4.3x), HTN (6.2x). Uncontrolled HbA1c strongly associated with CKD (OR=3.9), CAD (OR=2.3), CHF (OR=3.1), CVD (OR=4.2), HTN (OR=3.5).
Alzahrani et al., 2025 [24]	Semaglutide efficacy and tolerability	HbA1c, weight, discontinuation rate	In adherent patients with diet/exercise, HbA1c decreased 8.2%→6.9% ($p=0.001$), weight 97→89.2 kg ($p<0.001$). Discontinuation rate 25.2% due to adverse effects. Effective but tolerability limits long-term adherence.
Aljulajil et al., 2025 [25]	PHC physicians' knowledge of DPP-4 inhibitors	Knowledge, attitude, prescribing practices	86.3% knew low hypoglycemia risk; 60.9% recognized them as newer agents. Knowledge significantly associated with age, experience, qualifications, and educational resource availability. Positive attitudes overall, but knowledge gaps exist.
Surrati et al., 2025 [26]	Clinical inertia in insulin prescription	Awareness, barriers (patient/physician/system)	Only 48% aware of "therapeutic inertia". Key barriers: concern for hypoglycemia (64.5%), treatment complexity (55.5%), patient resistance to lifestyle changes (66%), lack of multidisciplinary teams (68.5%), time constraints (53.5%). Professional classification significantly associated with awareness.
Aman Allah et al., 2025 [27]	Telehealth vs in-person glycemic control	HbA1c change	Telehealth group HbA1c reduction: -0.52 vs in-person: -0.12 ($p=0.012$). Logistic regression showed no significant difference ($p=0.053$), indicating telehealth is not inferior and may be effective for glycemic control in PHC.
Alfadhly et al., 2026 [28]	Clinical inertia among family physicians	Awareness of "clinical inertia"; barriers to intensification	31.6% unaware of "clinical inertia"; 78.3% comfortable with injectables. Main barriers: lack of support staff (48.7%), concern about adherence (47.6%), unfamiliarity with new options (45.9%). 58.4% would not intensify if near HbA1c target.
Innab et al., 2026 [29]	Behavioral/demographic factors and glycemic control	HbA1c, self-management, health distress, self-efficacy	Mean HbA1c 8.23 (poor control). Females had better values. Significant negative correlation between HbA1c and self-management ($r=-0.48$). Self-management, BMI, sex, comorbidity, medication count, and health distress predicted glycemic control ($p<0.05$).

Albasheer et al., 2026 [30]	Gender differences in knowledge, control, and CV risk	Diabetes knowledge, HbA1c, FRS	Women had higher knowledge than men (59.5% vs 44.6%). Suboptimal control in both (only 19.9% had HbA1c <7%). Physical inactivity high (55.7%). Men had higher smoking and FRS. Gender-sensitive education and targeted interventions needed.

Table 3. Risk of Bias Assessment of Included Studies

Study (Author, Year [Ref])	Study Design	Assessment Tool	Risk of Bias Judgment	Key Limitations
Alshaikh et al., 2021 [7]	Cross-sectional	JBI Checklist	Moderate	Single city, convenience sampling, self-reported lifestyle factors
Alsaidan et al., 2021 [8]	Retrospective cohort	Newcastle-Ottawa Scale	Moderate	Single center, retrospective data extraction, potential incomplete records
Alsaleh et al., 2022 [9]	Cross-sectional	JBI Checklist	Moderate	Self-reported awareness, single region, convenience sampling
Alfulayw et al., 2022 [10]	Cross-sectional	JBI Checklist	Moderate	Online recruitment, self-reported adherence, potential selection bias
Alarfaj et al., 2023 [11]	Cross-sectional	JBI Checklist	Moderate	Single PHC center, self-reported knowledge and practice
Almutairi N et al., 2023 [12]	Pre-post interventional	JBI Quasi-Experimental	Moderate	No control group, single-arm design, limited generalizability
Albadrani et al., 2023 [13]	Cross-sectional	JBI Checklist	Moderate	Single city, convenience sampling, cross-sectional design
Sharahili et al., 2023 [14]	Retrospective cross-sectional	JBI Checklist	Low	Large sample, objective laboratory data, but single center and retrospective
Alguwaihes et al., 2023 [15]	Cross-sectional	JBI Checklist	Low	Multicenter, standardized methodology, but cross-sectional and no statistical comparisons between groups
Homady et al., 2023 [16]	Cross-sectional	JBI Checklist	Moderate	Single town, cross-sectional, self-reported QoL measures
Hussein et al., 2023 [17]	Retrospective cohort	Newcastle-Ottawa Scale	Moderate	Single center, retrospective, electronic records may have missing data
Alnaim et al., 2023 [18]	Retrospective cross-sectional	JBI Checklist	Moderate	Two centers, retrospective, incomplete screening data
Almutairi N et al., 2024 [19]	Cross-sectional	JBI Checklist	Moderate	Cross-sectional, self-reported behaviors, single time point
AlSofiani et al., 2024 [20]	Cross-sectional (physicians)	JBI Checklist	Moderate	Web-based survey, self-reported prescribing, potential response bias
Tourkmani et al., 2024 [21]	Prospective pre-post	JBI Quasi-Experimental	Moderate	No control group, single health system, short follow-up

Almulhim et al., 2024 [22]	Mixed-methods RCT (feasibility)	Cochrane RoB 2	Low	Small sample (feasibility), high retention, but limited power for efficacy
Karim et al., 2025 [23]	Cross-sectional	JBI Checklist	Moderate	Cross-sectional, single city, three sites but limited generalizability
Alzahrani et al., 2025 [24]	Retrospective cohort	Newcastle-Ottawa Scale	Moderate	Single clinic, retrospective, selective adherence analysis
Aljulajil et al., 2025 [25]	Cross-sectional (physicians)	JBI Checklist	Moderate	Single region, self-reported knowledge, cross-sectional
Surrati et al., 2025 [26]	Cross-sectional (physicians)	JBI Checklist	Moderate	Single city, self-reported perceptions, cross-sectional
Aman Allah et al., 2025 [27]	Retrospective case-control	Newcastle-Ottawa Scale	Moderate	Retrospective, two groups, potential selection bias
Alfadhly et al., 2026 [28]	Cross-sectional (physicians)	JBI Checklist	Moderate	Single city, self-reported, cross-sectional
Innab et al., 2026 [29]	Cross-sectional	JBI Checklist	Moderate	Single city, cross-sectional, self-reported behaviors
Albasheer et al., 2026 [30]	Cross-sectional	JBI Checklist	Moderate	Single region, cross-sectional, self-reported knowledge and behaviors

DISCUSSION

The prevalence of T2DM in Saudi Arabia has reached alarming proportions, with recent meta-analyses reporting a pooled prevalence of 16.4% (95% CI: 11.6–17.5) among the general population between 2000 and 2020 [31]. More contemporary estimates suggest that 18–25% of adults are affected by T2DM, with an additional 20–30% having prediabetes [32]. Approximately 23.1% of the adult Saudi population is diabetic, yet only 22.5% maintain adequate glycemic control as defined by HbA1c levels <7% [33]. The studies included in this review consistently reflect this epidemiological reality, with multiple investigations documenting mean HbA1c levels ranging from 7.69% to 10.47% across diverse primary care populations. Almutairi N et al. [19] reported that 74.5% of participants had uncontrolled HbA1c (>7%), while Innab et al. [29] found a mean HbA1c of 8.23% and Albasheer et al. [30] noted that only 19.9% achieved the target of HbA1c <7%. These findings are remarkably consistent with a recent study conducted in 15 primary care centers in Madinah, which reported a mean HbA1c of 8.39 ± 1.7% and glycemic goals achieved in only 15.7% of patients [34]. The consistent pattern of suboptimal glycemic control across multiple regions and studies underscores the systemic nature of this challenge and suggests that despite the availability of free medications and high levels of healthcare access through governmental primary healthcare centers, as noted by Alfulayw et al. [10], significant barriers to effective diabetes management persist.

The burden of diabetes-related complications documented in this review is substantial and comparable to findings from other Middle Eastern settings. Alnaim et al. [18] reported a microvascular complications prevalence of 55.1%, with nephropathy being the most common (80.2%), followed by retinopathy (32.7%) and neuropathy (8.4%). Alsaidan et al. [8] documented cardiovascular disease incidence of 11.2% and nephropathy incidence of 10.4% over a mean follow-up of 7.14 years. The CAPTURE sub-study by Alguwaihes et al. [15] found a weighted CVD prevalence of 18%, with atherosclerotic CVD accounting for 82.4% of cases. These figures are broadly consistent with findings from neighboring Bahrain, where a cross-sectional study of 585 patients attending primary care centers found that 51.6% had at least one diabetes-related complication, with neuropathy (27.0%) and retinopathy (15.2%) being the most frequent microvascular complications [35]. Similarly, an international study across 33 countries reported that 19% of patients had microvascular and 13.2% had macrovascular complications [36]. Karim et al. [23] demonstrated that a diabetes duration of five years or more significantly increased the risk of chronic kidney disease (2.1-fold), coronary artery disease (3.2-fold), cerebrovascular disease (4.3-fold), and hypertension (6.2-fold), findings that align with the well-established relationship between diabetes duration and complication risk observed globally. The relatively shorter time to development of complications reported by Alsaidan et al. [8]—with a mean time of 5.5 years to the first complication—is concerning and suggests either more aggressive disease progression in this population, delayed diagnosis, or suboptimal management, or a combination of these factors.

This review identified significant gaps in patient knowledge, awareness, and adherence behaviors that represent major barriers to optimal diabetes management in Saudi primary care settings. The awareness studies included in this review revealed a paradoxical pattern: while general awareness of diabetes-related complications was relatively high, specific knowledge regarding preventive practices and the importance of regular monitoring remained suboptimal. Alsaleh et al. [9] found that 93.5% of participants knew that diabetes could cause eye disease, yet only 63.3% agreed that regular eye examinations are necessary, and 57% believed there was no need to visit an ophthalmologist if diabetes was under control. Similarly, Albadrani et al. [13] reported that only 42.1% of patients had good knowledge of diabetic retinopathy, with 10.8% having poor knowledge. These findings are consistent with broader regional data; a study from central Saudi Arabia found that only 29.2% of participants demonstrated high diabetes-related knowledge, while 36.4% had low knowledge [37]. Another study from Makkah reported an average self-awareness score of 6.8 ± 3.9 out of a possible 13, indicating substantial knowledge gaps [38]. The persistence of misconceptions about diabetes—such as the belief that excessive sugar consumption alone causes diabetes (62.4%) or that natural honey does not raise blood glucose (33.2%)—further highlights the need for sustained and culturally tailored health education initiatives [39].

Medication adherence emerged as a critical concern, with Alfulayw et al. [10] reporting that only 46.7% of participants were adherent to their diabetes medications, while adherence to lifestyle modifications was described as "low and unsatisfactory." The most frequently cited factors contributing to noncompliance were forgetfulness, lack of knowledge about diabetes and the importance of controlling it, side effects of medications, and difficulty in following a healthy diet. These findings resonate with evidence from across the Gulf Cooperation Council (GCC) countries, where research indicates that medication compliance is generally fair, but dietary patterns and physical activity remain areas of significant concern [40]. A call-to-action from the Middle East emphasized that therapeutic non-adherence is a major contributor to suboptimal disease control in the region, with studies from Bahrain reporting that only 19.5% of patients with chronic diseases in primary care were adherent to their medications [41]. The association between sociodemographic factors and adherence observed in this review—including age, marital status, occupation, comorbidities, diagnosis period, and previous complications—suggests that adherence interventions need to be tailored to specific patient subgroups. The finding by Alarfaj et al. [11] that knowledge significantly influenced self-insulin administration practices further underscores the importance of patient education as a foundation for adherence.

Perhaps the most concerning finding from this review relates to the prevalence of clinical inertia among primary care physicians managing T2DM in Saudi Arabia. Clinical inertia—the failure to initiate or intensify therapy when treatment goals are not met—represents a major barrier to achieving optimal glycemic control and preventing complications. Surrati et al. [26] found that only 48% of family physicians were aware of the concept of therapeutic inertia, while Alfadhly et al. [28] reported that 31.6% were completely unfamiliar with the term "clinical inertia." These findings are consistent with international literature documenting widespread clinical inertia in diabetes management; a study from India found that multiple factors contribute to therapeutic inertia, including provider-related factors such as clinical conservatism and concerns about hypoglycemia [42]. The barriers identified in the Saudi studies were multifaceted, operating at the patient, physician, and system levels. Physician-related factors included concern about hypoglycemia (64.5%), complexity of treatment (55.5%), and patient refusal (33.5%). Patient-related barriers included resistance to lifestyle modifications (66.0%), fear of weight gain (52.5%), and fear of injections (50.5%). System-level barriers included lack of multidisciplinary teams (68.5%), time constraints (53.5%), and high workload (52.0%) [26]. Alfadhly et al. [28] additionally identified lack of support staff such as nursing and diabetes educators (48.7%), concern over patient adherence (47.6%), and lack of information or understanding of new treatment options (45.9%) as major barriers. The finding that 58.4% of physicians believed it was appropriate not to intensify treatment for patients who were close to their HbA1c target, despite not having met it, is particularly concerning and reflects a dangerous complacency that may contribute to the persistence of suboptimal glycemic control.

The prescribing patterns documented in this review reveal significant gaps between evidence-based guidelines and real-world practice. AlSofiani et al. [20] found that sulfonylurea remains the most frequently prescribed second-line agent (50% of physicians), despite the availability of newer agents with proven cardiovascular and renal benefits. Only 23.6% of patients received glucose-lowering agents with demonstrated cardiovascular benefit in the CAPTURE sub-study [15], and AlSofiani et al. [20] reported that cost was a major consideration preventing the prescription of GLP-1 receptor agonists (75% of specialists, 65% of generalists) and SGLT-2 inhibitors (57% of specialists, 71% of generalists). These findings align with a broader Middle Eastern call-to-action highlighting that therapeutic inertia at the healthcare provider and system levels is a major contributor to suboptimal disease control in the region [41]. The underutilization of agents with proven cardiovascular benefit is particularly concerning given the high prevalence of cardiovascular disease among Saudi T2DM patients and the strong association between uncontrolled HbA1c and cardiovascular comorbidities documented by Karim et al. [23]. The knowledge gaps regarding newer therapeutic options identified by Aljulajil et al. [25], where only 60.9% of primary care physicians recognized DPP-4 inhibitors as a relatively new therapeutic option, further highlight the need for continuous medical education and updated prescribing guidelines.

Despite the challenges identified, this review also identified several promising interventional strategies that have demonstrated effectiveness in improving glycemic control and diabetes self-management in Saudi primary care settings. The patient activation-tailored intervention by Almutairi N et al. [12] achieved significant improvements in HbA1c (from 8.38% to 7.55%), BMI (from 30.90 to 29.16), patient activation scores (from 54.74 to 61.58), and multiple domains of diabetes self-care activities. These findings are consistent with the broader evidence base linking patient activation to improved health outcomes; Almutairi N et al. [19] demonstrated in a cross-sectional study that higher patient activation levels were positively associated with better glycemic control and self-management behaviors including diet, physical activity, blood glucose self-testing, foot care, and smoking cessation. The concept of patient activation—an individual's knowledge, skill, and confidence in managing their health—has gained increasing recognition as a critical driver of self-management success [43]. The feasibility study by Almulhim et al. [22] similarly demonstrated high rates of eligibility (90%), recruitment (79%), and retention (97%) for a health coaching intervention, with notable improvements in HbA1c, BMI, waist circumference, self-efficacy, and diabetes self-care in the intervention group. Participants reported high satisfaction with the intervention and advocated for its expansion, suggesting that patient-centered, coaching-based approaches are both acceptable and effective in the Saudi context.

The hybrid model of in-person and telemedicine care evaluated by Tourkmani et al. [21] achieved a remarkable reduction in HbA1c from 10.47% to 7.87% (mean reduction 2.59%, $p < 0.001$) among patients with uncontrolled T2DM. This finding is particularly significant given the growing evidence supporting the effectiveness of virtual care in diabetes management. A systematic umbrella review of 30 systematic reviews found that 28 reported that virtual care improved HbA1c compared to usual care, with a meta-analysis of 16 reviews revealing a mean difference of -0.37% (-0.41% to -0.32%) [44]. The telehealth study by Aman Allah et al. [27] demonstrated that telehealth was non-inferior to in-person care, with a greater reduction in HbA1c in the telehealth group (-0.52 vs -0.12, $p = 0.012$), although logistic regression did not show a significant difference ($p = 0.053$). These findings suggest that telemedicine and hybrid models can address some of the system-level barriers identified in this review, including time constraints, high workload, and limited access to multidisciplinary teams. The effectiveness of semaglutide in improving glycemic control and promoting weight loss, as demonstrated by Alzahrani et al. [24] (HbA1c reduction from 8.2% to 6.9%, weight reduction from 97 kg to 89.2 kg, $p < 0.001$) and supported by real-world evidence from Al-Abdulkarim et al. [45] showing median HbA1c reduction from 8.9% to 7.8% ($p < 0.0001$) and BMI reduction from 34.8 to 32.6 kg/m² ($p < 0.0001$), provides an additional therapeutic option for patients who have not achieved adequate control with conventional therapies. However, the 25.2% discontinuation rate due to adverse effects reported by Alzahrani et al. [24] and the increased overall cost associated with these agents highlight the need for careful patient selection, monitoring, and cost-effectiveness considerations.

The findings of this review align closely with international evidence on diabetes management in primary care settings, while also revealing some context-specific challenges and opportunities. The prevalence of suboptimal glycemic control documented in Saudi Arabia (with only 15.7–22.5% achieving HbA1c <7%) is comparable to or worse than many other settings. A study from Bahrain found that 59.7% of patients had uncontrolled diabetes, while a Tanzanian study reported that 57.6% had microvascular complications [35, 36]. The high prevalence of clinical inertia among Saudi physicians is consistent with international findings; studies from Spain, India, and other countries have documented similar patterns of delayed treatment intensification [42, 46]. The barriers to optimal care identified in this review—including patient-related factors such as fear of injections and resistance to lifestyle changes, physician-related factors such as concerns about hypoglycemia and treatment complexity, and system-level factors such as lack of multidisciplinary teams and time constraints—are remarkably consistent across different healthcare systems and cultural contexts [41, 47].

However, some findings from this review are particularly noteworthy in the Saudi context. The relatively short time to development of complications (mean 5.5 years) reported by Alsaidan et al. [8] is shorter than that reported in many international studies and may reflect the combination of young age at diagnosis, high prevalence of obesity, and genetic predisposition in the Saudi population. The lower than global CVD prevalence (18% vs 34.8% in the global CAPTURE study) reported by Alguwaihes et al. [15] may reflect differences in patient characteristics, potential genetic protective factors, or underdiagnosis due to poor coordination between care settings. The association between female gender and worse outcomes—including lower HRQOL, higher HbA1c, and higher rates of neurocognitive dysfunction—documented by multiple studies [7, 16, 30] is an important finding that warrants further investigation and targeted interventions. The significant gender differences in diabetes knowledge (59.5% of women vs 44.6% of men having appropriate knowledge) reported by Albasheer et al. [30] suggest that health education strategies need to be gender-sensitive and tailored to the specific needs and circumstances of male and female patients.

The findings of this systematic review have several important implications for policy and practice in Saudi Arabia. First, there is an urgent need for systematic quality improvement initiatives targeting glycemic control in primary care settings. The consistent pattern of suboptimal HbA1c levels across multiple studies and regions suggests that current approaches to diabetes management are insufficient and that more intensive, patient-centered strategies are required. The success of the patient activation-tailored intervention [12] and the hybrid telemedicine model [21] provides a roadmap for such initiatives. Second, addressing clinical inertia requires multifaceted interventions at the physician, patient, and system levels. Physician education programs should focus not only on clinical knowledge but also on overcoming psychological barriers to treatment intensification, including concerns about hypoglycemia and polypharmacy. The establishment of multidisciplinary diabetes care teams, including diabetes educators, dietitians, and nurses, as recommended by Surrati et al. [26] and Alfadhly et al. [28], is essential to support primary care physicians and improve patient outcomes. Third, patient education and activation should be prioritized as core components of diabetes care. The low levels of disease-specific knowledge, the prevalence of misconceptions, and the high rates of non-adherence documented in this review highlight the need for ongoing, culturally tailored health education programs that empower patients to take an active role in their diabetes management. Fourth, efforts to improve access to newer glucose-lowering agents with proven cardiovascular and renal benefits, such as GLP-1 receptor agonists and SGLT-2 inhibitors, should be prioritized, particularly for patients with established cardiovascular disease or high cardiovascular risk. The cost barriers identified by AlSofiani et al. [20] need to be addressed through policy interventions, including expanded formularies and revised reimbursement mechanisms.

Limitations

This review is limited by the predominance of cross-sectional designs (precluding causality), significant clinical/methodological heterogeneity (preventing meta-analysis), reliance on self-reported data, geographical concentration in urban centers (limiting generalizability), and a moderate overall risk of bias across the included studies.

CONCLUSION

Primary care T2DM management in Saudi Arabia is suboptimal (only 15–22% achieve glycemic targets) due to poor patient adherence (46.7%), physician clinical inertia (48% aware, 31.6% unfamiliar), and system-level deficits (68.5% lack multidisciplinary teams). Promising interventions—patient activation, hybrid telemedicine, and health coaching—offer viable solutions. Multi-level, evidence-based strategies, including provider education, team-based care, and digital health integration, are urgently needed to mitigate complications and achieve the health objectives of Saudi Vision 2030.

REFERENCES

[1] Atlas D. International diabetes federation. IDF Diabetes Atlas, 7th edn. Brussels, Belgium: International Diabetes Federation. 2015;33(2):3-6.

[2] Ong KL, Stafford LK, McLaughlin SA, Boyko EJ, Vollset SE, Smith AE, Dalton BE, Duprey J, Cruz JA, Hagins H, Lindstedt PA. Global, regional, and national burden of diabetes from 1990 to 2021, with projections of prevalence to 2050: a systematic analysis for the Global Burden of Disease Study 2021. The Lancet. 2023 Jul 15;402(10397):203-34.

[3] Liu J, Li M, Yang Z, Liu D, Xiao T, Cheng J, Su H, Ou CQ, Yang J. Rising trend and regional disparities of the global burden of disease attributable to ambient low temperature, 1990-2019: An analysis of data from the Global Burden of Disease 2019 study. Journal of Global Health. 2024 Apr 19;14:04017.

[4] Aharon-Hananel G, Dori-Dayan N, Zemet R, Bakal L, Jabarin A, Levi K, Hemi R, Barhod E, Kordi-Patimer O, Mazaki-Tovi S, Cukierman-Yaffe T. The relationship between neonatal hypoglycaemia and cord blood C-peptide levels in neonates of birthing individuals with type 1 diabetes. Diabetes/Metabolism Research and Reviews. 2024 Jan;40(1):e3714.

[5] Jarrar MT, Abusalah MA, Albaker W, Al-Bsheish M, Alsyouf A, Al-Mugheed K, Issa MR, Alumran A. Prevalence of type 2 diabetes mellitus in the general population of Saudi Arabia, 2000–2020: A systematic review and meta-analysis of observational studies. Saudi Journal of Medicine & Medical Sciences. 2023 Jan 14;11(1):1.

[6] Beard A, Trotter SC. JAK 1-3 inhibitors and TYK-2 inhibitors in dermatology: Practical pearls for the primary care physician. Journal of Family Medicine and Primary Care. 2024 Oct 18;13(10):4128.

[7] Alshaikh AA, Alatawi HS, Alzahrani AM. Neurocognitive dysfunction among type 2 diabetes patients attending primary health care in Jeddah, Saudi Arabia. Journal of Family Medicine and Primary Care. 2021 Nov 5;10(10):3803.

[8] Alsaidan M, Alkhenizan A, Amber ST, Alsoghayer S, AlFakhri L, Abudaia J. Incidence of cardiovascular complications and nephropathy in patients with type 2 diabetes in a primary care setting in Riyadh, Saudi Arabia. Diabetes, Metabolic Syndrome and Obesity. 2021 Apr 15:1663-7.

[9] Alsaleh M, Alasmari AH, Al-Amer AS. Awareness of diabetic retinopathy among patients with type-2 diabetes mellitus in Abha, Saudi Arabia: A survey-based research study. Journal of Family Medicine and Primary Care. 2022 Jun 30;11(6):2717.

[10] Alfulayw MR, Almansour RA, Aljamri SK, Ghawas AH, Alhussain SS, Althumairi AA, Almuthaffar AA, Alhuwayji KA, Almajed AA, Al-Yateem SS, Alamri AS. Factors contributing to noncompliance with diabetic medications and lifestyle modifications in patients with type 2 diabetes mellitus in the eastern province of Saudi Arabia: a cross-sectional study. Cureus. 2022 Nov 28;14(11).

[11] Alarfaj RM, Alayed D, Alarfaj R. Knowledge and practice of use of insulin therapy among patients with type 2 diabetes attending primary health care centers, Riyadh, Saudi Arabia: a cross-sectional study. Cureus. 2023 Feb 26;15(2).

[12] Almutairi N, Gopaldasani V, Hosseinzadeh H. The Effect of a Patient Activation Tailored Intervention on Type 2 Diabetes Self-Management and Clinical Outcomes: A Study From Saudi Arabian Primary Care Settings. Journal of Diabetes Research. 2023;2023(1):2074560.

[13] Albadrani MS, Alrehaili AM, Alahmadi SH, Aljazaeri AA, Almaghthawi OF, Alanazi SN, Alrehaili OA, Albadrani M, Alrehaili A, Almaghthawi Sr OF, Alanazi S. Awareness of diabetic retinopathy among patients with type 2 diabetes mellitus in primary healthcare centers in Madinah, Saudi Arabia: a cross-sectional study. Cureus. 2023 Nov 30;15(11).

[14] Sharahili AY, Mir SA, ALDosari S, Manzar MD, Alshehri B, Al Othaim A, Alghofaili F, Madkhali Y, Albenasy KS, Alotaibi JS. Correlation of HbA1c level with lipid profile in type 2 diabetes mellitus patients visiting a primary healthcare center in Jeddah City, Saudi Arabia: a retrospective cross-sectional study. Diseases. 2023 Oct 31;11(4):154.

[15] Alguwaihes AM, Alhozali A, Yahia MM, Abdel-Nabi T, Hatahet MH, Albalkhi NI, Al Sifri S. The prevalence of cardiovascular disease in adults with type 2 diabetes mellitus in Saudi Arabia-CAPTURE study. Saudi Medical Journal. 2023 Jan;44(1):57.

[16] Homady A, Albasheer O, Bajawi A, Hamdi S, Awaf A, Madkhali T, Sabai A, Zaino MR, Somaili M. Health-related quality of life among type 2 diabetes patients in Southern Province of Saudi Arabia using WHOQOL-BREF: A cross-section study. Current Diabetes Reviews. 2023 Sep 1;19(7):55-64.

[17] Hussein G, Al Saud AA, Siddiqi AM, Khasawinah A, Alenezi A, Mohammed RA, Alendijani YA, Al Saud A, Mohammed R. The impact of continuity of care on health indicators in patients with type 2 diabetes mellitus in family medicine clinics in Riyadh. Cureus. 2023 Aug 13;15(8).

[18] Alnaim MM, Alrasheed A, Alkhateeb AA, Aljaafari MM, Alismail A. Prevalence of microvascular complications among patients with type 2 diabetes mellitus who visited diabetes clinics in Saudi Arabia. Saudi Medical Journal. 2023 Feb;44(2):211.

[19] Almutairi N, Gopaldasani V, Hosseinzadeh H. Relationship between patient activation and type 2 diabetes Mellitus Self-management and clinical outcomes in Saudi Arabian primary care setting. American Journal of Health Promotion. 2024 Jul;38(6):767-77.

[20] AlSofiani ME, AlHalees DZ, Aljebreen JA, Dahesh JA, Bamogaddam GS, AlBraithen GM, Jammah A, Alsufyani M, AlBraithen G. Factors influencing the choice of glucose-lowering medications among physicians treating patients with type 2 diabetes. Cureus. 2024 Feb 8;16(2).

[21] Tourkmani AM, Alharbi TJ, Rsheed AM, Alotaibi AF, Aleissa MS, Alotaibi S, Almutairi AS, Thomson J, Alshahrani AS, Alroyli HS, Almutairi HM. A hybrid model of in-person and telemedicine diabetes education and care for management of patients with uncontrolled type 2 diabetes mellitus: findings and implications from a multicenter prospective study. Telemedicine Reports. 2024 Feb 19;5(1):tmr-2024.

[22] Almulhim AN, Alhowaish A, Madani A, AlQaddan M, Altuwalah AS, Goyder E. Feasibility and acceptability of a tailored health coaching intervention to improve type 2 diabetes self-management in Saudi Arabia: a mixed-methods randomised feasibility trial. BMJ open. 2024 May;14(5):e078631.

[23] Karim SI, Sattar K, Ahmad T, Memon MK, Alqahtani AS, Alsubiheen AM, Alrashed FA. Cardiovascular and renal comorbidities among saudi patients with type 2 diabetes: A cross-sectional observational study. Plos one. 2025 May 27;20(5):e0324233.

[24] Alzahrani M, Rammal L, Felemban R, Khan M, Saad H, Alrezqi M, Alsulami N, Alabdullatif A, Alawashiz Z, Rammal LA, Felemban RM. Effects of semaglutide on glycemic control and body weight in patients with type 2 diabetes: A retrospective cohort study in a primary care setting. Cureus. 2025 Apr 12;17(4).

[25] Aljulajil F, Rabbani U. Assessment of Knowledge and General Attitudes of Primary Care Physicians Toward Dipeptidyl Peptidase-4 (DPP-4) Inhibitor Drugs in the Management of Type 2 Diabetes Mellitus in the Qassim Region. Cureus. 2025 Jun 29;17(6).

[26] Surrati AM, Alshanqiti A, Albadrani M, AlHarbi M, Abu Baker Tobaiqi M. Clinical inertia in insulin prescription for patients with type 2 diabetes mellitus among family physicians in Saudi Arabia. JPMA. The Journal of the Pakistan Medical Association. 2025 Jun 1;75(6):892-901.

[27] Aman Allah AM, Malibarey WM, Bin Baz SS, Alsalmi HA, Alkattan AN, Attar HK. Impact of Telehealth on Glycemic Control in People Diagnosed with Type 2 Diabetes: A Retrospective Cohort Study. Saudi Journal of Health Systems Research. 2025 Feb 10;5(2):55-63.

[28] Alfadhly AF, Althomali RN, Asiri AA, Alhothaly SK, Alhoshan FM, Almajnouni AS, AlMalki BM, Alfaez SM, Alharthi RF, Amalki AA, Albaqami AM. Saudi family physician's clinical inertia of type 2 diabetes management. Journal of Family Medicine and Primary Care. 2026 Mar 20;15(2):865.

[29] Innab A, Kerari A. Behavioral and demographic factors associated with glycemic control in adults with type 2 diabetes mellitus: a cross-sectional study. BMC Health Services Research. 2026 Feb 19;26(1):398.

[30] Albasheer O, Mahfouz MS, Alssum A, Majrashi M, Hamdi A, Alhazmi WM, Hakami BH, Awaf AA, Hassan R, Rajeh N, Solan T. Gender differences in diabetes knowledge, glycemic control, and cardiovascular risk among adults with type 2 diabetes: a cross-sectional study. Frontiers in Endocrinology. 2026 Mar 13;17:1763252.

[31] Jarrar MT, Abusalah MA, Albaker W, Al-Bsheish M, Alsyouf A, Al-Mugheed K, Issa MR, Alumran A. Prevalence of type 2 diabetes mellitus in the general population of Saudi Arabia, 2000–2020: A systematic review and meta-analysis of observational studies. Saudi Journal of Medicine & Medical Sciences. 2023 Jan 14;11(1):1.

[32] Effectiveness of lifestyle interventions in the prevention of type 2 diabetes mellitus in primary care settings in Saudi Arabia. Comed Journal. 2023. Available at: www.comedjournal.com.

[33] Al-Slail FY, Jumah IM, Abdelfadil KO, Fadl SM, Almutairy AO, Alanazi AF, Kheir OO. The Effect of Motivational Interviewing on Glycemic Control Among Saudi Persons with Type 2 Diabetes: A Feasibility Study. Saudi Medical Journal. 2026 Feb 7;47(2):273.

[34] Alfadhli E, Surrati AM, Masoud RS, Gadi YA, Alahmadi WA, Turkistani MK. The Status of Metabolic Control in Patients With Diabetes Attending Primary Care Clinics in Madinah, Saudi Arabia. Medicina. 2025 Oct 16;61(10):1856.

[35] Alawainati M, AlGhareeb N, Najem W, AlGhareeb M, Alhouli R, Alqallaf A, Buhejji M, Almulla A, Obaid S, AlRabiah J, Hussain L. Epidemiology of Macrovascular and Microvascular Complications Among Patients With Diabetes Mellitus in Primary Care in Bahrain. Cureus. 2025 Dec 14;17(12):e99184-.

[36] Ouddoud H, Lescano JI, Belangoy KP, Nishimura Y, Harada K, Hagiya H, Vu QT, Iwata N, Higashionna T, Takeda T, Zamami Y. Diabetes Burden in the Middle East and North Africa Region, 1990–2023: An Ecological Time-Trend Analysis of GBD Estimates. Medicina. 2026 Jul 13;62(7):1352.

[37] Alsaidan AA, Alanazi MI, Thirunavukkarasu A. Assessment of diabetes-related knowledge and dietary patterns among type 2 diabetes mellitus patients in Central Saudi Arabia: insights for tailored health education strategies. InHealthcare 2025 Jan 24 (Vol. 13, No. 3, p. 233). MDPI.

[38] Alawi H, Khogeer H, Azab Y, Aljumayi S, Alzahrani A, Fatani I, Boshnag M, Mutair W, Hasan M, Almalki A, Mutair N. Identification of Factors Associated with Self-awareness among Diabetic Patients Attending AlZaher Primary Health Care Center in Makkah AlMukarramah City 2024. EVOLUTIONARY STUDIES IN IMAGINATIVE CULTURE. 2024:3170-82.

[39] Tawiah S. Understanding the motivations and barriers to seeking medical care for diabetic foot complications among diabetic smokers: a qualitative study. Oklahoma City University; 2025.

[40] Thirunavukkarasu A, Alsaidan AA. Self-management behaviours in type 2 diabetes across Gulf Cooperation Council Countries: an updated narrative review to enhance patient care. InHealthcare 2025 Sep 8 (Vol. 13, No. 17, p. 2247). MDPI.

[41] Almahmeed W, Alabadla Z, Al Awadi F, Alrohmaihi D, AlShamiri M, Elbadawi H, El-Tamimi H, Elzouki AN, Farghaly M, Hafidh K, Hassanein M. Improving therapeutic adherence and reducing therapeutic inertia in the management of people with cardiometabolic diseases: a call-to-action from the Middle East. Advances in Therapy. 2025 Mar;42(3):1340-59.

[42] Sonmez A, Sabbour H, Echtay A, Rahmah AM, Alhozali AM, Al Sabaan FS, Haddad FH, Iraqi H, Elebrashy I, Assaad SN, Bayat Z. Current gaps in management and timely referral of cardiorenal complications among people with type 2 diabetes mellitus in the Middle East and African countries: Expert recommendations. Journal of diabetes. 2022 May;14(5):315-33.

[43] Hosseinzadeh H, Verma I, Gopaldasani V. Patient activation and Type 2 diabetes mellitus self-management: a systematic review and meta-analysis. Australian Journal of Primary Health. 2020 Dec 14;26(6):431-42.

[44] Ravi S, Meyerowitz-Katz G, Yung C, Ayre J, McCaffery K, Maberly G, Bonner C. Effect of virtual care in type 2 diabetes management–a systematic umbrella review of systematic reviews and meta-analysis. BMC health services research. 2025 Mar 6;25(1):348.

[45] Al-Abdulkarim HA, Alqahtani NS, Al-Shraim M, Almohammed OA. Real-world clinical and budget impact of semaglutide in type 2 diabetes mellitus in tertiary hospital in Saudi Arabia. Frontiers in Clinical Diabetes and Healthcare. 2025;6:1677695.

[46] Mata-Cases M, Benito-Badorrey B, Roura-Olmeda P, Franch-Nadal J, Pepió-Vilaubí JM, Saez M, Coll-de-Tuero G, GEDAPS (Primary Care Group for the study of Diabetes) of the Catalonian Society of Family and Community Medicine. Clinical inertia in the treatment of hyperglycemia in type 2 diabetes patients in primary care. Current medical research and opinion. 2013 Nov 1;29(11):1495-502.

[47] Stern C, Valenzuela C, Whitehorn A, Pollock D, Minooee S, Gohil DA, Zhu Z, Kirkpatrick P, Loureiro R, Davies E, Cardoso D. Evidence synthesis methodology for questions relating to barriers and enablers in health care: a scoping review. JBI evidence synthesis. 2026 Mar 1;24(3):459-513.