

Management of Diabetes in Saudi Arabia: Role of Family Medicine, Emergency, and Internal Medicine

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ABSTRACT

Background: The Kingdom of Saudi Arabia (KSA) is grappling with a severe and escalating diabetes epidemic, characterized by one of the world's highest prevalence rates, imposing a substantial burden on its healthcare system and economy. **Objectives:** This review article aims to synthesize the distinct yet complementary roles of Family Medicine, Emergency Medicine, and Internal Medicine in managing diabetes within the Saudi context. It further analyzes the influential socioeconomic and cultural factors that impact patient outcomes. **Methods:** A comprehensive review of the literature was conducted over the past 10 years to include studies related to diabetes epidemiology, management protocols, and health services research in Saudi Arabia and exclude irrelevant studies and studies published out of 10 years range. Data from national surveys, peer-reviewed journals, and clinical guidelines were synthesized to present a holistic overview. **Results:** The epidemiology of diabetes in KSA is alarming, with a prevalence of 18.3% among adults and an equally high rate of pre-diabetes (18.0%). Family Medicine serves as the cornerstone for prevention, early detection, and long-term management but faces challenges in adherence to process-of-care measures. Emergency Medicine is critical for managing acute complications like Diabetic Ketoacidosis (DKA) and Hyperglycemic Hyperosmolar State (HHS), where protocol-driven care is vital. Internal Medicine provides specialized, holistic care for complex cases, emphasizing cardiorenal protection with advanced pharmacotherapy. Underpinning these clinical efforts are powerful socioeconomic determinants, including cultural dietary habits, low health literacy, economic barriers, and specific gender dynamics, which significantly shape self-management and adherence. **Conclusion:** Curbing the diabetes epidemic in Saudi Arabia necessitates an integrated, multi-pronged strategy that strengthens collaboration between family physicians, emergency physicians, and internists.

Keywords: Diabetes Mellitus, Saudi Arabia, Family Medicine, Emergency Medicine, Internal Medicine, Socioeconomic Factors, Healthcare Management.

INTRODUCTION

Diabetes mellitus represents one of the most formidable and escalating public health challenges of the 21st century, with its global prevalence having reached pandemic proportions ¹. This chronic metabolic disorder, characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both, is a leading cause

of morbidity, mortality, and healthcare expenditure worldwide. It is a primary driver of catastrophic complications, including cardiovascular disease, stroke, chronic kidney disease, lower-limb amputations, and adult-onset blindness, placing an immense burden on healthcare systems and societies at large ¹.

The Kingdom of Saudi Arabia is at the epicenter of the diabetes epidemic, with prevalence rates that are among the highest in the Middle East and North Africa (MENA) region and the world. Recent epidemiological data paint a concerning picture. A nationwide cross-sectional study conducted as part of the Saudi Health Interview Survey found the weighted prevalence of total diabetes (both physician-diagnosed and undiagnosed based on glycated hemoglobin levels) among Saudi adults to be 18.3%². This indicates that nearly one in every five adults in the Kingdom is affected by the disease. The situation is further exacerbated by a high prevalence of pre-diabetes, estimated at around 18.0%, signaling a vast reservoir of individuals at imminent risk of progressing to full-blown diabetes². This dual burden of established and impending disease underscores the critical need for effective prevention strategies. The economic impact is equally staggering; a study evaluating the direct annual cost of diabetes in KSA estimated it to be USD 0.84 billion (SAR 3.16 billion), a figure that reflects only the direct medical costs and does not account for indirect costs such as lost productivity and premature mortality³. The drivers of this epidemic are multifaceted, deeply rooted in the nation's rapid socioeconomic development, which has led to profound lifestyle changes. These include the widespread adoption of sedentary behaviors, dietary shifts towards energy-dense and processed foods, and increasing rates of obesity⁴. The genetic predisposition of the Arab and South Asian populations, which constitute a significant portion of the Saudi demographic, also contributes significantly to this susceptibility⁵.

The clinical management of diabetes is inherently complex, requiring a lifelong commitment to glycemic control, regular monitoring for complications, and significant lifestyle modifications. This complexity necessitates a seamless, integrated care model that leverages the unique strengths of various medical specialties. In the Saudi healthcare system, three key disciplines are positioned at the forefront of this battle: Family Medicine, Emergency Medicine, and Internal Medicine (specifically, Endocrinology). Each plays a distinct yet interdependent role across the continuum of care, from prevention and early diagnosis to acute intervention and long-term complication management. The role of Family Medicine is foundational and pivotal. As the first point of contact within the healthcare system, family physicians are uniquely positioned to lead efforts in primary prevention through community education and screening for high-risk individuals⁶. They are responsible for the initial diagnosis, initiation of first-line therapy, and the provision of continuous, comprehensive, and patient-centered care. This includes routine follow-up, titration of medications, management of uncomplicated hypertension and dyslipidemia, and providing essential self-

management education and support⁷. A strong primary care framework led by family physicians is crucial for reducing the burden of diabetes and preventing its progression.

However, despite best efforts in primary care, acute and life-threatening complications of diabetes frequently occur, bringing the patient into contact with the Emergency Department (ED). The perspective of Emergency Medicine is therefore critical in the diabetes care paradigm. Emergency physicians are tasked with the rapid diagnosis and stabilization of acute metabolic crises such as Diabetic Ketoacidosis (DKA), Hyperosmolar Hyperglycemic State (HHS), and severe hypoglycemia⁸. These conditions represent significant causes of morbidity and mortality and require immediate, expert intervention. Furthermore, the ED often serves as a safety net for patients with poorly controlled diabetes who may have limited access to regular primary care, making it a potential site for re-engagement into the healthcare system. The management in the ED is not only about acute resuscitation but also about appropriate disposition—determining which patients can be safely discharged with close follow-up and which require inpatient admission for further management⁸. This interface between emergency and primary or specialty care is a critical juncture that can significantly influence patient outcomes.

For patients with complex, advanced, or refractory disease, the perspective of Internal Medicine, particularly the endocrinologist, becomes indispensable. Internists and endocrinologists manage the most challenging cases of diabetes, including those requiring complex insulin regimens, multiple daily injections, or insulin pump therapy. They possess the specialized expertise to manage severe and persistent complications, interpret complex diagnostic tests, and integrate new therapeutic technologies like continuous glucose monitoring systems⁹. Their role is essential in managing the multi-system manifestations of diabetes, often in a hospital inpatient setting or a dedicated tertiary care clinic. The referral pathway from family medicine to internal medicine ensures that patients receive a tiered level of care appropriate to the complexity and severity of their condition. Therefore, the synergy between these three specialties—Family Medicine, Emergency Medicine, and Internal Medicine—is not just beneficial but imperative for a holistic and effective national diabetes management strategy.

Epidemiology of Diabetes in Saudi Arabia:

The Kingdom of Saudi Arabia (KSA) has undergone one of the most rapid demographic and epidemiological transitions globally, shifting the burden of disease from communicable to non-communicable diseases (NCDs), with diabetes mellitus at the forefront of this public health crisis¹⁰. The nation has transformed from a society with a

low prevalence of diabetes a few decades ago to one now grappling with some of the highest rates in the world. This dramatic surge is intrinsically linked to the profound socioeconomic development, urbanization, and subsequent lifestyle changes that have occurred since the discovery of oil. The "westernization" of lifestyle, characterized by decreased physical activity due to increased vehicle dependence and a climate that discourages outdoor exercise, coupled with a nutritional shift towards high-calorie, processed foods and sugar-sweetened beverages, has created a perfect storm for the explosion of type 2 diabetes (T2DM) ^{4, 11}.

Recent, robust, nationally representative studies have quantified the staggering burden of diabetes in the Saudi adult population. This indicates a massive subpopulation with impaired glucose tolerance, representing a pool of approximately 3.7 million individuals at high risk of progressing to full-blown diabetes, thereby guaranteeing the continued growth of the epidemic for the foreseeable future without urgent and effective intervention strategies. These findings are consistent with data from the International Diabetes Federation (IDF), which consistently ranks Saudi Arabia among the top ten countries globally for both the highest prevalence of diabetes and the highest proportion of undiagnosed cases ¹.

The distribution of diabetes is not uniform across the Kingdom, with significant variations observed by region, age, and gender as illustrated in table (1).

Table 1: Regional Variation in Diabetes Prevalence in Saudi Arabia ^{7- 12}

Region	Prevalence (%)
Central (Riyadh)	31.1%
Western (Jeddah, Makkah)	29.8%
Eastern (Dammam, Al-Ahsa)	28.9%
Northern	26.1%
Southern	25.3%

This regional variation can be attributed to differences in the degree of urbanization, lifestyle factors, and access to healthcare services. From a demographic perspective, prevalence increases sharply with age. While relatively low in the 20-30 age group, it escalates dramatically, exceeding **40%** in individuals over the age of 50 ¹³. Historically, studies indicated a higher prevalence in women, which was often linked to higher rates of obesity and more sedentary lifestyles among females ¹⁴. However, more recent data suggests the gap is narrowing, with some studies now showing a comparable or even slightly higher prevalence in men, reflecting changing societal roles and lifestyle patterns ^{2, 15}.

Analyzing the temporal trends of diabetes prevalence in KSA reveals a deeply concerning and accelerating trajectory. Earlier studies from the 1990s and early 2000s already indicated a rising problem. For

instance, a study in the Al-Hasa region in 2004 reported a prevalence of 12.0% ¹⁶. A follow-up study in the same region a decade later demonstrated a significant increase, highlighting the rapid pace of the epidemic at a local level.

The drivers of this relentless rise are multifaceted. The primary catalyst is the obesity epidemic, which is a major independent risk factor for T2DM. The Kingdom has one of the highest rates of obesity globally, with a national prevalence of **33.7%** among adults and an even more alarming rate of **40.0%** for overweight ⁴. The combination of a genetic predisposition in Arab and South Asian populations and an obesogenic environment creates a potent mix ^{5, 11}. Furthermore, the high prevalence of consanguinity in the region may contribute to the aggregation of genetic risk factors for diabetes and its complications ⁵. The aging of the population, while a sign of successful public health measures in other areas, also contributes to the growing diabetes burden, as age remains one of the strongest non-modifiable risk factors for the disease.

While T2DM constitutes the vast majority (over 90%) of cases, the epidemiology of type 1 diabetes (T1DM) in Saudi children and adolescents is also a significant public health concern. KSA has one of the highest recorded incidences of T1DM in the Arab world and globally. A national registry-based study found the incidence of T1DM in children <15 years to be 27.5 per 100,000, with a peak incidence in the 10-14 age group ¹⁷. More disturbingly, there is a growing and clinically distinct phenomenon of early-onset T2DM appearing in adolescents and young adults. This is directly correlated with the surge in childhood obesity and a sedentary lifestyle from a very young age, leading to the emergence of a population that will face decades of living with diabetes and its debilitating complications, posing an unprecedented challenge to the healthcare system ¹³.

Beyond prevalence, the incidence rate—the number of new cases developing in a given period—provides insight into the dynamic growth of the epidemic. Longitudinal studies in KSA are limited, but available data indicates a high annual incidence. A study by **Alotaibi et al.** suggested that the incidence of T2DM is steadily increasing, further confirming that the pool of diabetic patients is expanding rapidly year on year ¹⁵. This translates directly into a staggering economic burden. The direct annual medical cost of diabetes in Saudi Arabia was estimated at USD 0.84 billion (SAR 3.16 billion) ³. This figure includes costs for medications, hospitalizations, and outpatient visits but excludes indirect costs such as lost productivity, disability, and premature mortality, meaning the true economic impact is substantially higher. As the number of affected individuals grows and more patients develop costly complications, this financial burden will continue to escalate, threatening the sustainability of the healthcare system.

Role of Family Medicine in Diabetes Management

In the face of the escalating diabetes epidemic in Saudi Arabia, the role of the healthcare system has shifted from a reactive, acute-care model to one that prioritizes continuous, comprehensive, and preventive care. At the heart of this paradigm shift is the discipline of Family Medicine, which serves as the cornerstone of effective long-term diabetes management. As the first point of contact and the primary navigator of the healthcare journey, family physicians are uniquely positioned to provide patient-centered care that spans the entire spectrum of the disease, from primary prevention in at-risk individuals to the management of complex multi-morbidity in established patients¹⁸. The World Health Organization (WHO) emphasizes that strong primary care is the most efficient and equitable way to address the growing burden of non-communicable diseases like diabetes¹⁹. The management of diabetes in primary care is built upon several core pillars that distinguish it from episodic specialty care. These include continuity of care, comprehensiveness, coordination, and a strong emphasis on prevention and patient education. The longitudinal relationship between a family physician and their patient, often spanning years or decades, fosters trust and a deep understanding of the patient's psychosocial context, cultural beliefs, and lifestyle challenges, all of which are critical determinants of self-management success²⁰. This continuity allows for the provision of comprehensive care that addresses not only glycemic control but also the holistic health of the individual. Family physicians are trained to manage the entire patient, including routine screening and management of common co-morbidities such as hypertension and dyslipidemia, which are integral to reducing cardiovascular risk²¹. Furthermore, they act as the central coordinator of care, referring patients to ophthalmologists for retinopathy screening, podiatrists for foot care, dietitians for medical nutrition therapy, and endocrinologists when complex management issues arise¹⁸.

A critical function of the Family Medicine center is the implementation of systematic screening and early detection programs. Given the high prevalence of undiagnosed diabetes and pre-diabetes in KSA, proactive screening of high-risk individuals—such as those with a family history of diabetes, obesity, hypertension, or a history of gestational diabetes—is a fundamental preventive strategy²².

By identifying dysglycemia in its earliest stages, family physicians can initiate timely lifestyle interventions that can delay or even prevent the onset of T2DM. For diagnosed patients, the family physician is responsible for developing and overseeing an individualized management plan. This includes the initiation and titration of first-line pharmacotherapy, predominantly metformin, and the subsequent rational

escalation of treatment, including other oral antihyperglycemic agents and non-insulin injectables, in accordance with clinical guidelines²³.

The cornerstone of effective diabetes care is empowering the patient to become an active manager of their own condition. Family physicians and their allied healthcare teams, including diabetes educators and nurses, are the primary providers of self-management education and support (DSMES). This involves structured education on key aspects of day-to-day management, such as blood glucose self-monitoring, medication adherence, foot care, sick-day rules, and, most critically, lifestyle modification²⁴.

In Saudi Arabia, where cultural norms and dietary habits pose significant challenges, culturally sensitive education is paramount. Family physicians can provide tailored advice on adapting traditional foods, incorporating physical activity into daily routines in a climate-appropriate manner, and addressing social barriers to lifestyle change²⁵.

Studies have consistently shown that structured diabetes education programs delivered in primary care settings lead to significant improvements in HbA1c, reduced cardiovascular risk factors, and enhanced patient knowledge and self-efficacy²⁶.

The effectiveness of Family Medicine in managing diabetes in Saudi Arabia is a subject of ongoing evaluation. While the model is theoretically sound, its practical implementation faces several significant challenges. Several Saudi-based studies have audited the quality of diabetes care in primary health care centers (PHCCs) and revealed gaps between clinical practice and international standards in table (2). A study evaluating adherence to the American Diabetes Association (ADA) guidelines in PHCCs found that while performance was strong in areas like blood pressure measurement and HbA1c testing, it was suboptimal for crucial processes such as annual foot examinations (~50%), lipid profile monitoring (~65%), and referral for annual dilated eye exams (~40%)²⁷.

Table 2: Adherence to Key Process of Care Measures in Saudi PHCCs^{27, 28}

Process of Care Measure	Reported Adherence in Saudi PHCCs
HbA1c tested at least twice yearly	> 80%
Blood Pressure measured at every visit	> 90%
Lipid Profile monitored annually	~ 65%
Annual Foot Examination	~ 50%
Referral for Dilated Eye Exam	~ 40%
Screening for Microalbuminuria	~ 55%

These gaps can be attributed to a confluence of factors. The sheer volume of patients, coupled with high physician-patient ratios and limited consultation times, often forces family physicians into a reactive, problem-focused approach rather than a proactive, preventive one²⁹. Furthermore, there is often a lack of structured, integrated diabetes education services and dedicated support staff (e.g., diabetes nurse educators, dietitians) within many PHCCs, placing the entire educational burden on the physician³⁰.

Patient-related factors, including low health literacy, cultural beliefs about illness and medication, and poor adherence to follow-up appointments, further complicate management³¹.

To fully realize the potential of Family Medicine in combating the diabetes epidemic, a multi-faceted strengthening of the primary care system is essential. Key recommendations include:

1. **Workforce Development and Training:** Continuous professional development programs focused on the latest diabetes management guidelines, motivational interviewing techniques, and the use of point-of-care testing (e.g., HbA1c machines) can enhance physician competency and efficiency³².
2. **Task Shifting and Multidisciplinary Teams:** Establishing dedicated diabetes clinics within larger PHCCs, staffed by a team comprising a family physician, a diabetes educator, a dietitian, and a nurse, can distribute the workload and provide more comprehensive care³³.
3. **Leveraging Technology:** The integration of electronic health records (EHRs) with clinical decision support systems can prompt physicians for overdue screenings and flag abnormal results. Telemedicine and mHealth applications can facilitate remote monitoring and patient education, improving access and continuity of care³⁴.
4. **Structured Recall and Follow-up Systems:** Implementing robust, automated recall systems for routine check-ups and screenings can help overcome the problem of lost-to-follow-up patients and ensure continuity of care³⁵.

Emergency Management of Acute Diabetic Complications

The management of diabetes extends far beyond the controlled environment of outpatient clinics, frequently intersecting with the high-stakes domain of the Emergency Department (ED). Acute metabolic complications of diabetes represent some of the most

critical and life-threatening emergencies encountered in clinical practice, requiring rapid diagnosis, immediate intervention, and meticulous monitoring to prevent mortality and significant morbidity. In Saudi Arabia, with its vast population of diabetic patients, the ED serves as a crucial safety net for those experiencing acute deteriorations in their condition²³. These crises, primarily Diabetic Ketoacidosis (DKA) and Hyperglycemic Hyperosmolar State (HHS), are often the initial presentation of type 1 diabetes (T1DM) or the consequence of inadequate control, intercurrent illness, or poor adherence in established type 2 diabetes (T2DM) patients²⁴.

DKA and HHS exist on a spectrum of hyperglycemic emergencies, sharing the common underlying themes of insulin deficiency and hyperglycemia, but differing significantly in their pathophysiology, rate of onset, and clinical features. DKA is characterized by the biochemical triad of hyperglycemia (blood glucose typically >250 mg/dL), metabolic acidosis (arterial pH <7.3, serum bicarbonate <18 mEq/L), and ketonemia²⁵.

It results from a severe absolute or relative insulin deficiency, leading to uncontrolled lipolysis and the production of ketoacids (acetoacetate and β -hydroxybutyrate). This causes a high-anion gap metabolic acidosis and an osmotic diuresis from hyperglycemia, resulting in profound dehydration and electrolyte loss²⁶. Clinically, patients typically present with a short history (often <24 hours) of polyuria, polydipsia, nausea, vomiting, and abdominal pain. Kussmaul respirations (deep, labored breathing) and a fruity odor of acetone on the breath are classic signs of the body's attempt to compensate for the metabolic acidosis²⁵.

In contrast, HHS is defined by extreme hyperglycemia (blood glucose often >600 mg/dL), profound hyperosmolality (effective serum osmolality >320 mOsm/kg), and the absence of significant ketoacidosis²⁷. It typically occurs in older adults with T2DM and is often precipitated by an acute illness—such as pneumonia, urinary tract infection, or myocardial infarction—that leads to reduced fluid intake. The key pathophysiological difference is the presence of just enough circulating insulin to suppress lipolysis and ketogenesis, but not enough to facilitate glucose uptake by muscles and the liver²⁸.

This results in severe hyperglycemia, leading to a massive osmotic diuresis that causes more extreme dehydration and hyperosmolality than seen in DKA. The neurological sequelae, including altered mental status, lethargy, focal deficits, and seizures, are the hallmark of HHS and are directly correlated with the degree of hyperosmolality²⁷ as illustrated in table (3).

Table 3: Key Diagnostic Differentiators Between DKA and HHS ^{25, 27}

Parameter	Diabetic Ketoacidosis (DKA)	Hyperglycemic Hyperosmolar State (HHS)
Typical Patient	Younger, often T1DM	Older, often T2DM
Onset	Rapid (<24 hours)	Slower (days to weeks)
Blood Glucose	>250 mg/dL	>600 mg/dL
Arterial pH	<7.30	>7.30
Serum Bicarbonate	<18 mEq/L	>18 mEq/L
Serum Ketones	Positive	Small or negative
Effective Osmolality	Variable, often <320 mOsm/kg	>320 mOsm/kg
Mental Status	Alert to somnolent	Stupor/Coma common

The management of DKA and HHS in the ED is simultaneous and revolves around five core principles: fluid resuscitation, insulin therapy, electrolyte repletion, identification and treatment of precipitating causes, and continuous monitoring ^{25, 29}.

- 1. Fluid Resuscitation:** Aggressive volume repletion is the first and most critical step in managing both DKA and HHS. It restores intravascular volume, improves tissue perfusion, and begins to correct hyperglycemia by enhancing renal glucose excretion ²⁹. The standard protocol involves administering an initial 1-2 liters of 0.9% normal saline over the first 1-2 hours. Subsequent fluid choice and rate are then guided by the patient's hemodynamic status, serum sodium levels, and hydration state, often switching to 0.45% saline. In HHS, the correction of fluid deficit must be more gradual, typically over 24-48 hours, to avoid a rapid fall in plasma osmolality that could precipitate cerebral edema ²⁷.
- 2. Insulin Therapy:** Continuous intravenous infusion of regular insulin is the standard of care ²⁵. An initial IV bolus (0.1 U/kg) is often recommended, followed by a continuous infusion (0.1 U/kg/hour). The goal is a steady decrease in serum glucose by 50-75 mg/dL per hour. Once blood glucose falls to around 200 mg/dL in DKA or 300 mg/dL in HHS, dextrose should be added to the IV fluids to prevent hypoglycemia while the insulin infusion is continued to clear ketones and correct acidosis in DKA ²⁹.
- 3. Potassium Repletion:** Total body potassium is universally depleted due to osmotic diuresis, but serum levels can be normal or even elevated initially due to acidosis. Once serum potassium is <5.5 mEq/L and urine output is confirmed, potassium should be added to the IV fluids (typically 20-40 mEq/L) to

maintain a serum level of 4-5 mEq/L ²⁵. Failure to monitor and replete potassium is a common cause of preventable death due to arrhythmias from hypokalemia induced by insulin therapy.

- 4. Identification of Precipitating Factors:** A crucial role of the emergency physician is to search for and initiate treatment of the underlying trigger. Common precipitating factors include infection (e.g., pneumonia, UTI), non-adherence to insulin therapy, new-onset diabetes, myocardial infarction, and cerebrovascular accident ²⁴. A thorough history, physical examination, and targeted investigations (e.g., complete blood count, cultures, cardiac enzymes, ECG) are mandatory.

The management of hyperglycemic emergencies in Saudi EDs faces unique challenges. Studies from the region indicate that protocol adherence can be variable. A study from a tertiary care center in Saudi Arabia found that while fluid resuscitation and insulin therapy were consistently initiated, the monitoring of electrolytes, particularly the timely checking of serum potassium and anion gap, was sometimes suboptimal ³⁰. Furthermore, the high patient volume and overcrowding in many public hospital EDs can strain resources, making the intensive monitoring required for these patients logistically difficult ³⁰. Another significant challenge is the high rate of recurrent DKA presentations, often linked to non-adherence to insulin therapy, which highlights a failure in the transition of care from the ED or inpatient setting back to robust primary and endocrine care ²³.

To optimize outcomes, Saudi EDs are increasingly adopting structured order sets and clinical pathways for DKA and HHS management. These tools standardize care, reduce medical errors, and improve adherence to evidence-based guidelines ^{8, 11, 29}. Additionally, enhancing education for emergency staff on the subtleties of managing HHS, which is often more lethal than DKA due to patient comorbidities and the severity of dehydration, is crucial ²⁷.

Internal Medicine’s Approach to Chronic Diabetes Care

The management of diabetes reaches its highest level of complexity within the domain of Internal Medicine, particularly the subspecialty of Endocrinology. While family medicine provides the foundation of continuous primary care and emergency medicine addresses acute crises, the internist is tasked with navigating the intricate landscape of advanced, complicated, and refractory diabetes ³⁰. This patient population often presents with a constellation of challenges, including prolonged duration of disease, failure to achieve glycemic control with multiple oral agents, requirement for complex insulin regimens, and the presence of multiple, significant diabetes-related complications and comorbidities ³¹.

The internist functions as a specialist in diagnostic reasoning and the management of multi-morbidity. For the diabetic patient, this means addressing the "ABCDEFs" of diabetes care: **A**1c, **B**lood pressure, **C**holesterol, **D**rugs to protect the kidneys and heart, **E**ye and foot care, and **F**ollow-up and self-management support³³. This comprehensive approach is critical because the leading cause of mortality in diabetic patients is not hyperglycemia per se, but cardiovascular disease (CVD)³⁴. Consequently, the internist's strategy is heavily focused on cardiovascular risk reduction. This involves aggressive management of hypertension to a target of <130/80 mmHg, often requiring multiple antihypertensive agents, with a strong preference for angiotensin-converting enzyme inhibitors (ACEIs) or angiotensin II receptor blockers (ARBs) due to their proven renoprotective effects³⁵. Similarly, the management of dyslipidemia with high-intensity statin therapy is a cornerstone of care, regardless of the baseline low-density lipoprotein (LDL) level, in most diabetic adults³⁶.

Furthermore, the internist is responsible for the systematic screening, diagnosis, and staging of diabetes-specific microvascular complications. This includes ordering and interpreting annual retinal exams for retinopathy, monitoring urine albumin-to-creatinine ratio (UACR) and estimated glomerular filtration rate (eGFR) for diabetic kidney disease (DKD), and conducting thorough neurological and vascular examinations for diabetic peripheral neuropathy and foot ulcer risk³⁷. The internist's role is to integrate the findings from these various organ systems to create a unified management plan. For instance, the diagnosis of DKD would not only prompt tighter blood pressure control and the use of an SGLT2 inhibitor but would also necessitate dosage adjustments for many medications cleared by the kidneys, including metformin and some insulin secretagogues³⁸.

When patients fail to achieve glycemic targets under primary care management, the internist employs a more advanced and nuanced pharmacotherapeutic arsenal. The selection of second- and third-line agents is no longer based solely on glucose-lowering efficacy but is increasingly guided by their proven cardiovascular and renal outcome benefits³⁹. The paradigm has shifted from a purely glucocentric view to a cardioreno-metabolic one. Two classes of medications, SGLT2 inhibitors and GLP-1 receptor agonists, have revolutionized the internal medicine approach due to their robust evidence base. Large cardiovascular outcomes trials (CVOTs) have demonstrated that specific drugs within these classes significantly reduce major adverse cardiovascular events (MACE), hospitalization for heart failure (particularly with SGLT2 inhibitors), and slow the progression of DKD⁴⁰.

This evidence has led internists to strategically select these agents for patients with established CVD, heart failure, or chronic kidney disease, irrespective of their baseline HbA1c⁴¹. The personalization of therapy also extends to considerations of weight (favoring GLP-1 RAs for significant weight loss), risk of hypoglycemia (favoring both classes for their low hypoglycemia risk), and specific patient preferences regarding route of administration (oral vs. injectable).

For patients requiring insulin, the internist manages the transition from basal-only to more complex regimens, such as basal-bolus therapy. This involves meticulous titration, education on carbohydrate counting, and troubleshooting issues like dawn phenomenon and Somogyi effect⁴². The initiation and management of insulin pump therapy (continuous subcutaneous insulin infusion) and real-time continuous glucose monitoring (rt-CGM) systems also fall squarely within the purview of the endocrinologist, requiring specialized expertise to interpret vast amounts of glycemic data and adjust therapy accordingly⁴³.

Table 4: Key Considerations for Advanced Antihyperglycemic Agents in Internal Medicine Practice^{39, 40}.

Therapeutic Class	Key Glycemic Effect	Cardio-Renal Benefits	Key Patient Profile for Selection
SGLT2 Inhibitors	Glucosuria, mild HbA1c reduction	Reduced HF hospitalization, CKD progression, MACE (some agents)	Patients with HF (EF preserved/reduced), CKD, or established ASCVD
GLP-1 Receptor Agonists	Glucose-dependent insulin secretion, glucagon suppression, slowed gastric emptying	Reduced MACE, weight loss, potential benefit in CKD (some agents)	Patients with established ASCVD or those needing significant weight loss
DP-4 Inhibitors	Glucose-dependent insulin secretion	Cardiovascular neutrality	When a well-tolerated, low-hypoglycemia-risk oral agent is needed
Insulin	Potent glucose-lowering	No CV outcome benefit; may increase weight and hypoglycemia risk	When other agents fail or are contraindicated; in brittle diabetes

The internal medicine model for chronic diabetes care is fundamentally team-based. The internist acts as the conductor of an orchestra of healthcare professionals⁴⁴. This team typically includes diabetes educators for self-management training, registered dietitians for medical nutrition therapy, clinical pharmacists for medication reconciliation and adherence counseling, podiatrists for high-risk foot care, and ophthalmologists for advanced retinopathy management⁴⁵.

The internist's ability to coordinate this team and ensure clear communication among its members is a critical determinant of patient success. In the Saudi context, a significant challenge is the fragmentation of care, where patients may see multiple specialists in different healthcare facilities without a central coordinator, leading to polypharmacy, contradictory advice, and poor outcomes³¹. The internist, often based in a tertiary care center, is ideally positioned to assume this coordinating role, ensuring that the care plan is unified and patient-centered.

Socioeconomic Factors Influencing Diabetes Management in Saudi Arabia

The management of diabetes is profoundly influenced by a complex web of factors that extend far beyond the clinical setting and into the fabric of daily life. In Saudi Arabia, the remarkable biological and clinical advancements in diabetes care are often moderated, and sometimes thwarted, by powerful socioeconomic and cultural forces⁴⁰ illustrated in table (5). Achieving optimal glycemic control and preventing complications is not merely a function of prescribing the correct medication; it is contingent upon a patient's ability to access, understand, afford, and adhere to a lifelong management plan⁴¹.

The rapid modernization of Saudi society has created a dissonance between traditional lifestyles and contemporary health demands. Culturally, the Saudi diet has shifted dramatically from its traditional composition of dates, whole grains, and lean meats to one high in refined carbohydrates, saturated fats, and sugar-sweetened beverages, heavily influenced by the globalization of fast-food chains⁴².

Furthermore, social gatherings and celebrations are often centered around the lavish offering of food and sweets, creating significant social pressure that can

undermine dietary adherence for diabetic individuals⁴³. Physical activity levels remain low, a trend exacerbated by a hot climate, high dependence on private vehicles, and limited public spaces conducive to exercise, particularly for women⁴⁴.

Health beliefs and perceptions also play a critical role. Studies have identified a concerning level of diabetes-related fatalism and misconceptions within the Saudi population. Some individuals perceive the diagnosis as an inevitable fate ("maktoob" or preordained), which can lead to passivity and poor engagement in self-care⁴⁵. Other common misconceptions include the belief that herbal remedies can replace prescribed medications, or that insulin therapy is a sign of end-stage disease and causes blindness or amputation⁴⁶.

Such beliefs can lead to dangerous delays in initiating or intensifying therapy, poor medication adherence, and a preference for unproven alternative treatments, ultimately resulting in poor glycemic control and an increased risk of complications.

While the Saudi government provides extensive healthcare coverage to its citizens, economic factors still pose significant barriers to effective diabetes management. The direct costs to the health system are substantial, but patients and families also face indirect and out-of-pocket expenses that can impact adherence⁴⁷. These include transportation costs for frequent clinic visits, co-payments for certain services or medications in some sectors, and the cost of supportive supplies like glucose test strips and healthy food options, which are often more expensive than energy-dense, processed alternatives⁴⁸.

For the large expatriate workforce in the Kingdom, who may have limited or costly health insurance, the financial burden is even more acute and can be a primary reason for treatment discontinuity⁴⁹.

A study on medication adherence found that cost was a frequently cited reason for non-adherence, particularly for newer classes of medications that may not be fully covered by all insurance schemes⁵⁰. Furthermore, economic productivity is impacted; poorly controlled diabetes leads to increased absenteeism from work and presenteeism (reduced productivity while at work), creating a vicious cycle where illness reduces income, which in turn compromises the ability to manage the illness effectively⁵¹.

Table 5: Socioeconomic Barriers to Diabetes Management in Saudi Arabia ⁴⁰⁻⁴⁷

Barrier Category	Specific Examples	Impact on Diabetes Management
Cultural & Lifestyle	<ul style="list-style-type: none"> • High-calorie traditional feasts • Social pressure to eat • Low physical activity norms • Climate limiting outdoor activity 	Poor dietary adherence, sedentary lifestyle, weight gain, and hyperglycemia.
Health Beliefs	<ul style="list-style-type: none"> • Fatalistic attitudes ("maktoob") • Fear and misconceptions about insulin • Belief in traditional remedies/alternative medicine over pharmaceuticals. 	Delayed treatment intensification, medication non-adherence, and use of unproven therapies.
Economic	<ul style="list-style-type: none"> • Indirect costs (transport, healthy food) • Variable insurance coverage for new drugs • Loss of income due to complications 	Financial stress leading to rationing of medications or monitoring supplies.
Gender Dynamics	<ul style="list-style-type: none"> • Cultural restrictions on female exercise • Women as primary caregivers, neglecting self-care 	Higher obesity rates among women, delayed self-care, and later presentation with complications.

Health literacy—the capacity to obtain, process, and understand basic health information to make appropriate health decisions—is a pivotal social determinant ⁵². In Saudi Arabia, studies have shown a correlation between low health literacy and poorer diabetes knowledge, higher HbA1c levels, and increased rates of complications ⁵³.

Gender dynamics also introduce unique challenges. Saudi women have a high prevalence of diabetes and obesity, influenced by cultural norms that can restrict opportunities for physical activity outside the home ⁵⁴. While societal transformation is underway, access to female-only gyms or safe outdoor spaces for exercise remains limited in many areas. Additionally, women often serve as the primary caregivers for diabetic family members, a role that can lead them to neglect their own health needs, resulting in delayed diagnosis and poorer management of their own condition ⁵⁵.

STUDY LIMITATIONS

This narrative review has several limitations inherent to its methodological design. As a comprehensive synthesis rather than a systematic review, it is subject to potential publication bias and does not employ a formal, reproducible protocol for study selection or quality assessment, which may affect the completeness and objectivity of the evidence presented. The inclusion of literature primarily in English, with a focus on Saudi-based studies, may have omitted relevant data published in other languages or from comparative regional studies.

Furthermore, the review integrates heterogeneous types of evidence—including national surveys, clinical studies, and guidelines—which, while providing a broad overview, limits the ability to perform unified quantitative analyses or draw definitive causal conclusions.

Finally, the rapidly evolving landscape of diabetes care means that some aspects of management, particularly pharmacotherapy, may advance beyond the latest literature included in this synthesis.

CONCLUSION

The management of diabetes in Saudi Arabia is a complex challenge that defies a singular solution. The perspectives of Family Medicine, Emergency Medicine, and Internal Medicine are not mutually exclusive but are essential, interlocking components of a comprehensive care continuum. Family Medicine provides the foundation of continuous care, Emergency Medicine offers a critical safety net for acute crises, and Internal Medicine delivers the specialized expertise for complex, multi-morbid disease. However, the efficacy of these clinical interventions is profoundly moderated by the socioeconomic and cultural landscape. Therefore, a sustainable solution requires a dual-pronged approach: first, fostering seamless collaboration and clear referral pathways among medical specialties, and second, implementing national public health initiatives that target health literacy, promote physical activity, enable healthy eating, and mitigate economic barriers. Only through such a unified, system-wide effort can the Kingdom hope to alter the trajectory of its diabetes epidemic and secure better health outcomes for its population.

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None.

Authors' Contributions

M.S.H. conceived the review and supervised the entire project. A.M.A., L.A.S., S.A.S., D.R.A., S.M.A., L.M.A., and N.S.A. conducted the literature review and drafted the initial manuscript sections. A.M.S., D.M.A., S.H.A., and N.S.A. provided critical revisions from the perspectives of internal medicine, family practice, and emergency medicine, respectively, ensuring comprehensive clinical relevance. All authors contributed to the manuscript's intellectual content, reviewed successive drafts, and approved the final version for submission.

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