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REVIEW

Diabetes Care in India

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Abstract

BACKGROUND Diabetes has become a major health care problem in India with an estimated 66.8 million people suffering from the condition, representing the largest number of any country in the world.

OBJECTIVE The rising burden of diabetes has greatly affected the health care sector and economy in India. The goal of health care experts in India is to transform India into a diabetes care capital in the world.

METHODS An expert detailed review of the medical literature with an Asian Indian context was performed.

FINDINGS Recent epidemiologic studies from India point to a great burden from diabetes. Diabetes control in India is far from ideal with a mean hemoglobin A1c of 9.0%—at least 2.0% higher than suggested by international bodies. Nearly half of people with diabetes remain undetected, accounting for complications at the time of diagnosis. Screening can differentiate an asymptomatic individual at high risk from one at low risk for diabetes. Despite the large number of people with diabetes in India, awareness is low and needs to be addressed. Other challenges include balancing the need for glycemic control with risk reduction due to overly tight control, especially in high-risk groups and taking into account health care professional expertise, attitudes, and perceptions. Pharmacologic care should be individualized with early consideration of combination therapy. Regular exercise, yoga, mindful eating, and stress management form a cornerstone in the management of diabetes.

CONCLUSIONS Considering the high cost incurred at various steps of screening, diagnosis, monitoring, and management, it is important to realize the cost-effective measures of diabetes care that are necessary to implement. Result-oriented organized programs involving patient education, as well as updating the medical fraternity on various developments in the management of diabetes, are required to combat the current diabetes epidemic in India.

KEY WORDS diabetes, diabetes care, India, obesity, prevention, screening, thin-fat Indian, type 1, type 2

INTRODUCTION

India lies to the north of the equator between 6° 44' and 35° 30' north latitude and 68° 7' and 97° 25' east longitude. India's coastline measures 7517 km in length; of this distance, 5423 km belong to peninsular India and 2094 km to the Andaman, Nicobar, and Lakshadweep island chains. The Indian

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climate is strongly influenced by the Himalayas and the Thar Desert. Four major climatic groupings are predominant in India: tropical wet, tropical dry, subtropical humid, and montane. Rapidly changing socioeconomic demographics have changed the global landscape of diabetes. Geographically, the prevalence of diabetes has been studied by many expert groups. The extreme locations contribute to variance in the diabetes prevalence rates, not only across the longitude and latitude, but also across rural and urban areas of the country.

EPIDEMIOLOGY

According to the International Diabetes Federation (IDF), there were an estimated 387 million individuals with diabetes worldwide in 2014, and this number is set to increase to 592 million by the 2035.[1]

Despite the large number of people with diabetes in southeast Asia, health care spending on the disease was estimated to be only US$6 billion, accounting for <1% of the global total, with India estimated to have spent the largest proportion. Adults in India alone account for 86% of this region's adult population of 883 million. India is experiencing an economic growth rate second only to China.[1] The projected increase in regional diabetes prevalence to 10.1% in 2035 is a consequence of ongoing large-scale urbanization and increasing life expectancy (in India, the proportion of the population age > 50 years is expected to increase from 27% to 35% between 2013 and 2035).[1] In 2013, an estimated 12,600 children age < 15 in the region developed type 1 diabetes (T1D).[1] India accounts for the majority of children with T1D, which has important consequences not only for the total region but also for worldwide estimates.[1] With 1.2 million deaths (14.2% of all adult deaths) in 2013, this region has the second highest number of deaths attributable to diabetes of any of the 7 IDF global regions (Africa, Europe, Middle East and North Africa, North America and Caribbean, South and Central America, Southeast Asia, and Western Pacific).[1] More than half (55%) of these deaths occurred in individuals age < 60 years and 27% in people < 50 years of age.[1] Increased mortality related to diabetes in India is related to poor overall health care, with 59.11% dying within 1 week of hospitalization with infection and chronic renal failure being the major causes of death, compared with cardio- and cerebrovascular disease in the West.[2] The pooled prevalence of rural diabetes among low- and middle-income countries has been estimated at 5.6% over a 25-year period.[1]

THIN-FAT INDIAN CONCEPT

Asian Indians have a small body size, which has been termed *thin-fat Indian*. Asian Indians have thinner limbs, which is suggestive of smaller muscle mass. However, despite their thinness, they are centrally obese, with a higher waist-to-hip ratio (WHR) and higher subscapular-to-triceps skinfold ratio than their British counterparts. Many studies show that Asian Indians have more body fat for any given body mass index (BMI) compared with whites and black Africans.[3] Asian Indians also have higher levels of central obesity (measured as waist circumference [WC], WHR, visceral fat, and posterior subcutaneous abdominal fat).[4] This is reflected in higher plasma nonesterified fatty acid (NEFA) and triacylglycerol (TG) concentrations, hyperinsulinemia with fasting as well as post-glucose challenge states, and higher insulin resistance (IR).[4] Thus, Asian Indians have an unusual thin-fat body composition associated with the IR syndrome.[5] In a 2007-2012 survey analysis, the prevalence of sarcopenia (low skeletal muscle mass) in India was 17.5% and sarcopenic obesity (high percent body fat with low skeletal muscle mass) 1.3%.[6] Mohan et al.[7] advanced the concept of the "Asian Indian phenotype": IR, increased abdominal obesity (higher WC despite lower BMI), lower adiponectin, and higher C-reactive protein levels.

DIABETES BURDEN IN INDIA: MEDICAL, SOCIAL, AND ECONOMIC

The diabetes burden in India results from various factors. Genetic predisposition combined with lifestyle changes and associated with urbanization and globalization, all together contribute to the rapid rise of diabetes in India. Ethnicity plays a role as well, and in one example, there are lower thresholds for the effect of BMI on age-adjusted type 2 diabetes (T2D) prevalence rates among Indians.[8] Moreover, T2D in the Indian population appears to occur at least a decade earlier than in Europeans.[7] Due to these sheer numbers, the economic burden due to diabetes in India is among the highest in the world. However, the real burden of diabetes is due to its micro- and macrovascular complications, which lead to increased morbidity and mortality.[1] It is also known that almost 50% of people with

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diabetes remain undetected and hence some may even present with micro- and macrovascular complications at the time of diagnosis.[7]

Although sporadic studies on the prevalence of diabetes have been available for several decades, reliable epidemiologic data only became available in India in the 1970s. Published studies vary in methodologies adopted and sampling frames; hence, any comparison of prevalence rates is, strictly speaking, not meaningful. The Indian Council of Medical Research (ICMR) study conducted in the 1970s reported a prevalence of 2.3% in urban areas; this number has risen to 12%-19% in the 2000s.[9] Correspondingly, in rural areas, prevalence rates have increased from around 1% to 4%-10% and even 13.2% in one study. Thus, it is clear that both in urban and rural India, prevalence rates of diabetes are increasing rapidly with a rough urban/rural divide of 2:1 to 3:1 being maintained through the past 2 to 3 decades, with the exception of Kerala (a coastal state in south India) where rural prevalence rates have caught up with or even overtaken urban prevalence rates.[9] The probable explanation for this exception is that in Kerala there is indeed no clear urban/rural demarcation and the whole of Kerala can now be considered to be urbanized.

Data on diabetes complications have been published by several authors, but until recently, they were only based on hospital or clinic experiences and therefore subject to referral bias. CURES (Chennai Urban Rural Epidemiology Study)[10] and CUPS (Chennai Urban Population Study)[11] provide the first population-based data from India on virtually all complications of diabetes. CURES was a population-based study involving 26,001 participants aged $\geq$20 years based on a representative population of Chennai. The overall prevalence of diabetic retinopathy based on 4-field stereo color retinal photography was 17.6%.[12] In other studies, the prevalence of retinopathy among Indians with diabetes ranged from 7.3% to 34.1%.[13-16] The prevalence of overt nephropathy was 2.2%, whereas that of microalbuminuria was 26.9%[17] and proteinuria 19.7%.[16] Peripheral neuropathy based on biothesiometry was seen in 26.1%,[18] which is comparable with other studies.[16]

In the CUPS study, coronary artery disease (CAD) was seen in 21.4% of patients with diabetes, 14.9% of patients with impaired glucose tolerance, and 9.1% of patients with normal glucose tolerance.[19] Additionally, peripheral vascular disease (PVD) was present in 6.3% of patients with diabetes compared with 2.7% in individuals without diabetes.[20] Patients with diabetes also had increased subclinical atherosclerosis as measured by intimal medial thickness at every age point, compared with those without diabetes.[21] The prevalence rate for hypertension among Indians with diabetes was 38% in one study.[16]

Based on a figure of about 40 million people with diabetes in India, there would be at least 7 million with retinopathy, 0.8 million with nephropathy, 10.4 million with neuropathy, 8.5 million with CAD, and 2.5 million with PVD. Thus, the burden due to diabetic complications is very high in India simply because of the large number of people with diabetes. These figures are in fact very conservative and it is possible that in rural areas, the prevalence of complications is much higher because of poorer control of diabetes and lack of access to health care.

Another population based study—the National Urban Diabetes Survey (NUDS)—was conducted in 6 large cities from different regions of India in 2001.[22] The study showed that the age standardized prevalence of T2D was 12.1%.[22] The prevalence was the highest in Hyderabad (16.6%), followed by Chennai (13.5%), Bengaluru (12.4%), Kolkata (11.7%), New Delhi (11.6%), and Mumbai (9.3%).[22] This study did not sample rural areas. PODIS (Prevalence Of Diabetes in India Study) was carried out in 49 urban and 59 rural centers in different parts of India to determine urban/rural differences in T2D.[23,24] When American Diabetes Association criteria were used, the prevalence of diabetes was 4.7% in urban and 1.9% in rural areas,[23] whereas the prevalence according to World Health Organization criteria was 5.9% in urban and 2.7% in rural areas.[24]

SCREENING

Individuals known to have diabetes represent the tip of the iceberg, as an equal or even larger number of patients have undiagnosed diabetes. Unfortunately, >50% of people with diabetes in India remain undiagnosed.[25] These individuals are at increased risk for developing diabetic complications. The ICMR-INDIAB (ICMR-India Diabetes)[9] study reported that the ratio of undiagnosed to diagnosed diabetes is higher in rural compared with urban areas. Thus, if diabetes is not detected early and treated adequately, there is a high risk for developing both macrovascular (CAD, cerebrovascular, and/or PVD) and microvascular disease (retinopathy, nephropathy, and neuropathy). Population data on micro- and macrovascular complications of diabetes are

available in urban India. However, such data are not available in rural India. This is largely because diabetes remains a neglected field in rural areas, as awareness levels and accessibility to diabetes health care remains woefully inadequate. Although the prevalence of diabetes is lower in rural India, the number of patients with diabetes in rural areas is much higher. This is because >70% of the population in India live in rural areas, and half of these individuals are below the poverty line and continue to fight for survival and health, although all of this is rapidly changing due to economic development.

The purpose of screening is to differentiate an asymptomatic person at high risk from one at low risk for diabetes. Screening may use a variety of methods (eg, risk assessment questionnaires, portable capillary blood assessments, and laboratory-based assessments) and various thresholds or cutoff points. Generally speaking, screening is appropriate in asymptomatic populations when the following 7 conditions are met:

1. The disease represents an important health problem that imposes a significant burden on the population.
2. The natural history of the disease is understood.
3. There is a recognizable preclinical (asymptomatic) stage during which the disease can be diagnosed.
4. Treatment after early detection yields benefits superior to those obtained when treatment is delayed.
5. Acceptable and reliable tests are available that can detect the preclinical stage of disease.
6. The costs of case finding and treatment are reasonable and are balanced in relation to health expenditures as a whole, and facilities and resources are available to treat newly detected cases.
7. Screening will be a systematic ongoing process and not merely an isolated one-time effort.[26]

Identifying accurate and low-cost methods is a necessary first step in assessing the cost-effectiveness of screening to detect undiagnosed diabetes. The Indian Diabetes Risk Score (IDRS) is more effective and significantly less expensive for screening for undiagnosed patients with T2D compared with genotyping *TCF7L2* singe nucleotide polymorphisms, the strongest genetic marker for T2D currently available.[27] Using IDRS screening before an oral glucose tolerance test reduces costs while still detecting a substantial portion of individuals newly diagnosed with diabetes.[27] A potential additional benefit of both the IDRS and genotyping is their ability to identify individuals who currently do not have diabetes but are at high risk for developing diabetes in the future. Thus, an individual with an IDRS $\geq$ 60 at baseline was 3 times more likely to develop diabetes in the future than an individual with an IDRS $<$ 30.[27] Studies are needed to assess the relative risk for developing diabetes among people with *TCF7L2* polymorphisms.

AWARENESS OF DIABETES IN INDIA

Not only are there many people with diabetes in India but awareness levels are low. Awareness and knowledge about diabetes was assessed among the general population, as well as in people with diabetes in Phase I of the ICMR-INDIAB study.[28] Only 43.2% of the overall study population had even heard about a condition called diabetes.[28] Overall, urban residents had significantly higher awareness rates than rural residents.[28] Among the general and diabetic population, 56.3% and 63.4%, respectively, were aware that diabetes could be prevented.[28] Not surprisingly, there was better knowledge regarding diabetes affecting other organs among the self-reported diabetic population (72.7%) than the general population (51.5%).[28] Thus, the results revealed that knowledge and awareness about diabetes in India, particularly in rural areas, is poor.

CURES reported that nearly 25% of the population was unaware of a condition called diabetes.[29] Only around 40% of the participants felt that the prevalence of diabetes was increasing and only 22.2% of the population and 41% of known patients with diabetes felt that diabetes could be prevented.[29] Although awareness levels increased with education, only 42.6% of postgraduates and professionals, which included doctors and lawyers, knew that diabetes was preventable.[29] The knowledge of risk factors of diabetes was even lower, with only 11.9% of study participants reporting obesity and physical inactivity as risk factors for diabetes.[29] More alarming was the fact that even among known people with diabetes, only 40.6% were aware that diabetes could lead to some organ damage.[29]

In another study that determined the level of awareness on diabetes in the urban adult Indian population, knowledge of the causes of diabetes, its prevention, and the methods to improve health was significantly low among the general population.[25] In the total study group, 41% were unaware of health being affected by diabetes and only <30% knew about complications related to kidneys, eyes, and nerves.[25] Many people with diabetes (46%) believed it was a temporary phenomenon.[25] Among individuals with diabetes, 92.3% had sought

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treatment from a general practitioner and only a small proportion sought out a specialist.[25]

CURRENT STATUS OF DIABETES CONTROL IN INDIA

The next challenge in India is that the quality of diabetes care varies considerably depending on awareness levels, expertise available, attitudes, and perceptions among health care professionals (HCP) in diabetes. In 1998, the Diabcare–Asia study was carried out to investigate the relationship between diabetes control, management, and late complications in a subset of an urban Indian diabetes population treated at 26 tertiary diabetes care centers.[30] In all, 2269 patients participated in this study and it was observed that approximately half had poor control hemoglobin A1c (A1C) >2% points above the upper limit of normal and mean A1C was significantly higher (8.9% ± 2.1%) than the levels recommended by the American Diabetes Association and the ICMR guidelines in India.[30] More than 54% of patients had diabetes-related complications. Mean A1C levels and frequency of complications were higher in patients with longer duration of diabetes.[30] This study also showed that 4% of patients were on diet therapy, 53.9% were receiving oral antidiabetic agents (OHA), 22% were receiving insulin, and 19.8% a combination of insulin and OHA.[30] This study concluded that with increasing duration of diabetes, glycemic control deteriorates, leading to late complications.[30] The study confirmed that diabetes care in India at that time left much to be desired and suggested the need for efforts to increase awareness among HCPs.[30] However, a subsequent 2013 study,[31] showed that that the majority (83.6%) of prescriptions for patients with diabetes adhered with guideline (2005 ICMR[32]) recommendations.

A similar large study, referred to as The IMPROVE Control India (ICI) study, involved 451 clinicians and 8 metropolitan cities of India.[33] The main objectives of the study were to shed light on doctors' and patients' knowledge, expectations, and attitudes regarding glucose control, and to understand the barriers to achieving good glucose control among patients and HCPs. There were many other barriers identified in terms of regular monitoring of diabetes status and lack of standardization in laboratory techniques. Surprisingly, the majority of these barriers involved the treating doctors as well. Moreover, even among patients whose A1C values were measured, 53% were not given glycemic targets as the study also reported relaxation of targets as duration of diabetes increased.[33] Difficulty in long-term maintenance of A1C targets were recognized by a majority of doctors. This might be one of the contributing factors for the lack of motivation to achieve good glycemic control by the patients.

PHARMACOLOGIC THERAPY IN DIABETES

A proactive approach to treating T2D is recommended: Therapy should be individualized with early consideration of combination therapy and ongoing reinforcement of lifestyle modification messages. Indeed, the conservative stepwise approach to T2D management involves lifestyle modification, followed by treatment with a single oral antidiabetic agent, often up-titrated to maximal recommended doses before combination therapy is introduced. Of note, the 2005 ICMR guidelines for pharmacologic treatment of diabetes[32] recommends metformin for higher BMI ($\geq$25 kg/m^2), but second-line for BMI 18.6 to 24.9 kg/m^2, and not at all in those patients who are underweight ($\leq$18.5 kg/m^2). The major pharmaceutical classes that may be combined with metformin include sulfonylureas (SU), thiazolidinedione (TZD), dipeptidyl-peptidase-4 inhibitor (DPP4-i), insulin, and glucagon-like peptide-1 (GLP-1) receptor agonists. Very often, there is a delay in advancing monotherapy (eg, metformin alone) to combination therapy (eg, metformin plus other pharmaceuticals, often SU) resulting in suboptimal glycemic control that increases the risk for micro- and macrovascular complications.

Few studies have investigated the effect of metformin-based early combination therapy. A systematic review and meta-analysis of 15 randomized controlled trials (RCTs; N = 6693) in patients with mean baseline A1C of 7.2% to 9.9% and mean diabetes duration of 1.6 to 4.1 years, with median follow-up of 6 months, showed that compared with metformin alone, combination therapy with metformin provided statistically significant reductions in A1C (weighted mean difference [WMD] −0.43%, 95% confidence interval [CI], −0.56 to −0.30), increases in attainment of A1C goal of <7% (relative risk [RR], 1.40; 95% CI, 1.33–1.48) and reductions in fasting plasma glucose (WMD −14.30 mg/dL; 95% CI, −16.09 to −12.51).[34] These results suggest a potential benefit of initial combination therapy on glycemic outcomes in diabetes compared with metformin monotherapy across a wide range of baseline A1C levels. Insulin therapy is the recommended

treatment of choice in patients with A1C > 10% to 11% or with symptoms of hyperglycemia.

NONPHARMACOLOGIC THERAPY IN DIABETES

Lifestyle modifications are the cornerstone of diabetes management and include a prescription for healthy eating, regular exercise, stress management, and avoidance of tobacco. The aim of dietary management is to achieve and maintain ideal body weight, euglycemia, and desirable lipid profile; prevent and postpone complications related to diabetes; and provide optimal nutrition during pregnancy, lactation, growth, old age, and associated conditions (eg, hypertension and catabolic illnesses). The recently published STARCH (Study To Assess the dietaRy CarboHydrate content of Indian type-2 diabetes population) study[35] shows that Indians consume larger amounts of carbohydrates than Americans (Table 1).[36] The comparison of macronutrients by region in India revealed similar patterns of dietary consumption, that is, relatively high carbohydrates and low fat and protein. This study dispels the myth that only south Indian people consume high carbohydrates in their diet (rice, idli [a savory cake; part of a traditional south Indian breakfast], etc.).[35]

Dietary transition and a sedentary lifestyle have led to an increase in obesity and diet-related noncommunicable diseases (T2D, cardiovascular disease, etc.) predominantly in urban, but also in rural areas. Dietary recommendations should be individualized according to person's ethnicity, cultural and family background, personal preferences, and associated comorbid conditions. These recommendations should be flexible in variety and preparation of food choices and timing of meals according to person's daily routine. The National Dietary Guidelines Consensus Group in India[37] developed some broad guidelines that recommend lower intake of carbohydrate, especially sugar, saturated fat, and salt, higher intake of fiber, and an optimal ratio of essential fatty acids. Medical nutrition therapy remains the first choice of treatment for the management of newly detected diabetes. The current controversies of carbohydrates, proteins, and fats still remain an area of ongoing research. However, there is enough evidence that medical nutrition therapy is an integral component of diabetes prevention, management, and self-management education.

Exercise is a powerful method to improve long-term glycemic control. It is clear that controlling blood glucose through modification of diet and lifestyle should be a mainstay of diabetes therapy. Regular exercise has been shown to improve blood glucose control, reduce cardiovascular risk factors, contribute to weight loss, and improve well-being. With increased physical activity, the selection of pre- and post-exercise meal and/or snacks becomes critical. A careful assessment of an individual should be made by a physician while incorporating an exercise program in the management. Exercise programs should be individualized according to individual capacity and disabilities.[38] People with diabetes must wear appropriate footwear for exercise.[38]

Evidence from the Diabetes Prevention Program[39] and the Finnish Diabetes Prevention Study[40] conducted in patients with prediabetes shows that appropriate lifestyle modification, including physical activity, can lead to reduced incidence of T2D by almost 58%. Studies have shown that resistance training and aerobic exercise are effective in improving the metabolic profile of adults with T2D.[41,42] In particular, supervised resistance training (maximum of 10 repetitions for >3 days per week) has been shown to lead to significant improvement in insulin sensitivity and values of A1C lipids, and truncal and peripheral subcutaneous adipose tissue in Asian Indians with T2D.[43] Additional physical activity >60 minutes per day would be helpful in maintaining a good glycemic profile for patients with T2D.[43] It has been reported that children and adolescents with T1D should complete a minimum of 30 to 60 minutes of moderate-intensity physical activity daily.[44] Yoga is a traditional and therapeutic Indian practice that promotes physical and mental health.[45] A yoga-based lifestyle modification program can reduce blood glucose, A1C TGs, total cholesterol,

Table 1. Region-wise Macronutrient Intake in Asian Indian Patients With and Without T2D*

Region of India	Total Carbohydrate % T2D/% non-T2D	Total Protein % T2D/% non-T2D	Total Fat % T2D/% non-T2D
North	63/67	15/13	22/20
East	65/65	16/14	19/21
South	64/66	14/10	22/24
West	61/66	14/11	25/23
Central	67/70	14/11	19/19

T2D, type 2 diabetes.

* Adapted from ref Phung et al.[35] Figures represent percent total daily kcal intake. Average US carbohydrate intake in 2007-2008 was 47.9% for men and 50.5% for women, protein intake 15.9% and 15.5%, and fat intake 33.6% and 33.5%.[36] Asian Indians consume more carbohydrates and less fat with or with T2D, but about the same amount of protein with T2D and less protein without T2D.

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Table 2. Key Findings for Diabetes Care in India

1. 387 million people were estimated to be suffering from diabetes worldwide in 2014; this number is set to increase to 592 million by 2035.
2. Adults in India alone account for 86% of Southeast Asia's adult population of 883 million. India accounts for the majority of the children with T1D, which has important consequences not only for the total region but also for worldwide estimates.
3. Asian Indians have an unusual thin-fat body composition associated with the insulin resistance syndrome and this is the now popular "thin-fat Indian" concept, or sarcopenic obesity.
4. The burden of diabetes in India requires focus on cost-effective measures of diabetes: early screening, tight metabolic control, monitoring of risk factors, and assessment of organ damage.
5. There are currently newer oral and injectible antidiabetes drugs with improved delivery systems to improve diabetes control.
6. In combination with pharmacologic therapy, ongoing reinforcement of lifestyle modification like regular exercise, yoga practice, mindful eating, and stress management form a cornerstone in management of diabetes.
7. Diabetes education for patients and updating the medical fraternity on various developments in diabetes management are required to combat the diabetes epidemic currently threatening the lives of millions of people in India.

T1D, type 1 diabetes.

and very low-density lipoprotein.[45] Mindful eating and yoga have health benefits on glycemic control in pregnant women with gestational diabetes in some studies.[46] Yogic exercises have enhanced the antioxidant defense mechanism in people with diabetes by reducing oxidative stress.[46]

CONCLUSIONS

Considering the enormous burden of diabetes in India, it is important to realize the necessary cost-effective measures of diabetes care: early screening, tight metabolic control, monitoring of risk factors, and assessment of organ damage. Economic analyses of diabetes care in India found that the cost of providing routine care is only a fraction of the overall cost and is perhaps still manageable. However, when this is not available or its quality is poor, the overall direct and indirect costs escalate with disastrous health and economic consequences to the individual, his or her family, and society, particularly due to the onset of the micro- and macrovascular complications of the disease. Published data from several epidemiologic, experimental human and animal studies, and from several large trials like the Diabetes Control and Complications Trial,[47] the Kumamoto study,[48] and the UK Prospective Diabetes Study Group[49] have convincingly demonstrated the importance of tight metabolic control in arresting and preventing the progression of target organ damage.

Over the past 2 decades, a better understanding of T2D pathophysiology has developed and newer oral and injectable antidiabetes drugs with improved delivery systems to improve diabetes control have become available. However, there are gaps between guidelines and real-life practice. In view of this, appreciation and understanding of both patient and physician barriers regarding proper monitoring and judicious use of therapeutic options, including insulin therapy, for optimizing diabetes management should be encouraged. Results-oriented organized programs involving patient education, updating medical fraternity on various developments in the management of diabetes, and providing them the opportunity to use and analyze these newer treatment options in the form of observational studies are required to combat the diabetes epidemic currently threatening to affect the lives of millions of people in India (Table 2).

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