

## STATE-OF-THE-ART REVIEW

# Diabetes Care in Malaysia: Problems, New Models, and Solutions



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### Abstract

**BACKGROUND** Diabetes is a major public health concern in Malaysia, and the prevalence of type 2 diabetes (T2D) has escalated to 20.8% in adults above the age of 30, affecting 2.8 million individuals. The burden of managing diabetes falls on primary and tertiary health care providers operating in various settings.

**OBJECTIVES** This review focuses on the current status of diabetes in Malaysia, including epidemiology, complications, lifestyle, and pharmacologic treatments, as well as the use of technologies in its management and the adoption of the World Health Organization chronic care model in primary care clinics.

**METHODS** A narrative review based on local available health care data, publications, and observations from clinic experience.

**FINDINGS** The prevalence of diabetes varies among the major ethnic groups in Malaysia, with Asian Indians having the highest prevalence of T2D, followed by Malays and Chinese. The increase prevalence of overweight and obesity has accompanied the rise in T2D. Multidisciplinary care is available in tertiary and primary care settings with integration of pharmacotherapy, diet, and lifestyle changes. Poor dietary adherence, high consumption of carbohydrates, and sedentary lifestyle are prevalent in patients with T2D. The latest medication options are available with increasing use of intensive insulin regimens, insulin pumps, and continuous glucose monitoring systems for managing glycemic control. A stepwise approach is proposed to expand the chronic care model into an Innovative Care for Chronic Conditions framework to facilitate implementation and realize better outcomes in primary care settings.

**CONCLUSIONS** A comprehensive strategy and approach has been established by the Malaysian government to improve prevention, treatment, and control of diabetes as an urgent response to this growing chronic disease.

**KEY WORDS** chronic care model, diabetes, Malaysia, multidisciplinary, programs, state-of-art, treatment

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## INTRODUCTION

Malaysia is situated in Southeast Asia and consists of 13 states and 3 federal territories with a total landmass of 329,847 square kilometers (127,350 square miles). Malaysia is separated by the South

China Sea into Peninsular Malaysia and East Malaysia. Malaysia is within the equatorial region, where a tropical rainforest climate is apparent year round. The capital city is Kuala Lumpur, and Putrajaya is the seat of the federal government. By 2015, with a population of more than 30 million, Malaysia

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became the 43rd most populous country in the world, and it is a multicultural society in which 67.4% of the population are ethnic Malays, 27.3% Chinese, and 7.3% Indians, according to the 2010 census. Malaysia's gross domestic product is US\$326.9 billion, according to 2014 figures from the World Bank, and the country has an open, upper middle income economy, with a growth rate of more than 7% per year for at least the last 25 years. Today, Malaysia has a diversified economy and has become a leading exporter of electrical appliances, electronic parts and components, palm oil, and natural gas. The national language of Malaysia is Bahasa Melayu (literally "Malay language"), though English is widely spoken as second language.

For the most part, health care in Malaysia is the responsibility of the government's Ministry of Health. Similar to many other developing nations, Malaysia has a 2-tiered health care system that consists of a government-run universal health care system and a coexisting private health care system. An extensive and comprehensive primary health care system enhances access to care. The national health priorities include optimizing the health care delivery system to increase access to quality care, as well as reducing the disease burden, for both communicable and non-communicable diseases. The key health challenges are prompted by changing disease patterns, such as a rising prevalence of noncommunicable diseases and their respective risk factors, a rapidly growing private sector with increasing out-of-pocket health care expenditures, and an expanding population of migrant workers who are at high risk for communicable diseases.

Diabetes is a major public health concern in Malaysia that is closely related to increased macro- and microvascular complications, as well as premature and preventable mortality. Over the past decade, there has been an increasing prevalence of type 2 diabetes (T2D) among adults aged  $\geq 30$  years in Malaysia. In 2011, the fourth Malaysian National Health and Morbidity Survey (NHMS IV) reported that the prevalence of T2D increased to 20.8%, affecting 2.8 million individuals, compared with the third National Health and Morbidity Survey (NHMS III), which reported a prevalence of 14.9% in 2006.<sup>1,2</sup> Among the major ethnic groups in Malaysia, Indians had the highest prevalence of T2D (24.9% in 2011 and 19.9% in 2006), followed by Malays (16.9% in 2011 and 11.9% in 2006), and Chinese (13.8% in 2011 and 11.4% in 2006).<sup>3,4</sup> Glycemic control among Malaysians with T2D continued to deteriorate, with the mean hemoglobin

A1c (A1C) rising to 8.66% in 2008, compared with 8.0% in 2003.<sup>3,4</sup> Furthermore, only 22% of people with T2D achieved A1C target  $< 7\%$ , the lowest rate since 1998.<sup>3</sup> Data from the online registry database—Adult Diabetes Control and Management—revealed ethnic differences in glycemic control wherein Chinese in Malaysia with T2D had the lowest mean A1C levels (7.8%) and Asian Indians in Malaysia had the highest (8.5%).<sup>5</sup>

The increase in the prevalence of T2D has contributed significantly to the parallel increase in the prevalence of overweight and obesity. The overall prevalence of abdominal obesity in Malaysia, measured by waist circumference, has been reported between 55.6% and 57.4%.<sup>6,7</sup> Epidemiologic studies investigating abdominal obesity in Malaysia have consistently shown an ethnic trend similar to that seen in T2D with prevalence being highest among Asian Indians (65.5%–68.8%), followed by Malays (55.1%–60.6%), Chinese (49.5%–51.1%), and other indigenous groups (44.9%–48.3%).<sup>6,7</sup> Obesity and diabetes have become inseparable where there has been a growing prevalence of abdominal obesity in people with T2D; indeed, obesity is observed in 75% of Malaysians with T2D.<sup>7</sup> Additionally, in the 2008 Malaysia DiabCare study, an undesirable waist circumference was reported in a higher proportion of women ( $\geq 80$  cm in 89.4%) than men ( $\geq 90$  cm in 73.7%) with T2D.<sup>3</sup> This study also found that 72% of people with T2D who were also obese had a mean body mass index (BMI) of 27.8 kg/m<sup>2</sup>.<sup>3</sup>

The National Obstetric Registry 2nd Report in 2010 reported that the incidence of diabetes in pregnancy was 9.90%.<sup>8</sup> The majority of these people had gestational diabetes (11,848 [8.66%]), whereas 1009 (0.74%) had pregestational diabetes.<sup>8</sup> Diabetes in pregnancy was highest among Asian Indians (14.39%), followed by Malays (11.37%) and Chinese (10.4%), with the majority between 31 and 40 years of age (48.3%).<sup>8</sup> In diabetes pregnancies, the caesarean section rate was higher (14.7%) compared with vaginal deliveries (8.5%).<sup>8</sup> Type 1 diabetes (T1D), known to be predominant among children and adolescents, is observed in 71.8% of patients.<sup>9</sup> The median age of diagnosis was 7.6 (interquartile range: 4.6, 10.8) years with diabetes duration of 3.3 years.<sup>9</sup> The majority (42.3%) of patients with T1D were between 10 to 15 years old and 57.5% presented with diabetic ketoacidosis. A positive family history for T1D or T2D was reported in 50.2% of patients.<sup>9</sup> About 11.8% of patients with T1D were overweight.<sup>9</sup> Among adults, T1D was prevalent in only 0.6% of the population.<sup>9</sup>

## DIABETES COMPLICATIONS

In the 2008 DiabCare study, screening for diabetes-related complications was performed in the majority of patients: 68% had eye screening, 64% had neuropathy screening, 48% had diabetes foot screening, and 97% had nephropathy screening.<sup>3</sup> Serum creatinine was the most used modality for assessing renal function, with 10% of people reporting values above 2 mg/dL.<sup>3</sup> Albuminuria testing was performed in only 29% of patients, and of those, 7% had microalbuminuria (30–300 mg/L) and 4.5% had macroalbuminuria (>300 mg/L).<sup>3</sup> Symptomatic neuropathy was present in 46% of patients.<sup>3</sup> The most common eye complications were cataract (27.2%) and nonproliferative retinopathy (22.8%), whereas severe late eye complications that were reported included photocoagulation (15.3%), proliferative diabetic retinopathy (13.7%), advanced eye disease (5.3%), and legal blindness (1.7%).<sup>3</sup> Among patients assessed for diabetic foot complications, leg amputation, vascular surgery, and active ulcer/gangrene were present in 3.8%, 2%, and 1.5%, respectively.<sup>3</sup> Among the cardiovascular complications, history of angina pectoris, myocardial infarction, angioplasty/coronary artery bypass graft, and stroke were reported in 18.4%, 12.1%, 13%, and 6.9%, respectively.<sup>3</sup>

The prevalence of combined microvascular complications (retinopathy, nephropathy, and neuropathy) was 75% and macrovascular complications (angina pectoris, myocardial infarction, angioplasty/coronary artery bypass graft, and stroke) was 29%.<sup>3</sup> Severe late complications (legal blindness, myocardial infarction, angioplasty/coronary artery bypass graft, cerebral stroke, end-stage kidney disease, and leg amputation) were present in 25% of patients at the time of the study.<sup>3</sup> Most of the complications increased with duration of diabetes.

In the most recent 2013 DiabCare study, microvascular complications were higher possibly as a result of improved rates of complication screening with foot examination, urinalysis, and retinal assessment, performed in more than 90% of patients within 12 months before the study.<sup>10</sup> However, cardiovascular complications were lower compared with the 2008 study, with the exception of cerebrovascular events, which were similar. This observation may be due to improved management of cardiovascular risk factors. In 2013, 61% of new dialysis patients had diabetes.<sup>11</sup> In 2010, the Ministry of Health recorded 23,800 deaths caused by diabetes.<sup>10</sup>

## DIABETES MANAGEMENT

**General Remarks.** In the 2011 NHMS IV, of those already diagnosed with diabetes, an estimated 1.1 million received treatment at public health care facilities.<sup>12</sup> Of those receiving public-based health care, an estimated 70% attended primary care clinics, whereas the remaining received treatment and follow-up at public hospitals.<sup>12</sup> Medical officers and physicians largely deliver public hospital-based diabetes care comprehensively within general medicine outpatient clinics. Consultations are focused on optimizing glycemic control with anti-hyperglycemic therapies (alone or in combination) and reinforcing lifestyle intervention while specifically addressing cardiovascular risk reduction.<sup>13</sup>

Diabetes care is generally available at major public hospitals at a state level. Patients are referred for consultations with dietitians, diabetes nurse educators, and pharmacists, mostly on an individual basis. Comprehensive care in hospital-based diabetes clinics includes regular screening for microalbuminuria, retinal photography, and foot examination as recommended by current clinical practice guidelines.<sup>14</sup> Those with suboptimal glycemic control despite first and second-line therapies, as well as having multiple comorbidities and complications, are referred to endocrinologists for further consultation and optimization of care.

There are established Diabetes Resource Centers in most hospitals where trained diabetes nurse educators deliver patient-centered diabetes education to inpatients and outpatients. Group-based diabetes education is not yet well established in the public hospital setting. In recent years, group-based diabetes education using the Diabetes Conversation Maps endorsed by the International Diabetes Federation has been popularized ever since the complete set was translated into Bahasa Melayu, the national language (Figure 1). The Ministry of Health has conducted training courses for diabetes nurse educators since 2004, and an estimated 900 diabetes nurse educators have been trained and practice in both primary care and hospital-based diabetes care.

The role of hospital pharmacists in the Malaysian comprehensive care model for diabetes deserves further discussion. Diabetes education incorporating the hospital pharmacist facilitates a focus on medication use, which, in effect, promotes better awareness and improved medication adherence. This strategy was initiated in 2006 in the Ministry of Health with the formation of Diabetes Mellitus Treatment Adherence Clinics, which are



**Figure 1.** Diabetes education class using Diabetes Conversation Map.

coordinated and operated by pharmacists. Currently, all major public hospitals have this facility, which has been recently extended to primary care clinics as well. Retrospective data of 43 patients attending Diabetes Mellitus Treatment Adherence Clinics in one public hospital in Penang, Malaysia found that participation improved medication adherence and glycemic control on follow-up.<sup>15</sup>

**Lifestyle Management.** Dietary management is considered to be one of the cornerstones of diabetes care. Successful diabetes management results from proper integration of healthy eating, physical activity, and, when needed, pharmacotherapy. Poor adherence with lifestyle recommendations was highly prevalent among Malaysian patients with T2D.<sup>3</sup> For instance, only 16.4% individuals with diabetes adhere to the dietary regimen provided by dietitians.<sup>16</sup>

There are limited studies assessing the dietary intake of Malaysian patients with diabetes. However, several surveys have been conducted in different settings. In 1993, Norimah and Abu Bakar<sup>17</sup> reported the dietary intake of patients with diabetes attending the University Kebangsaan Malaysia outpatient clinic, where the carbohydrate intake was 55%-59%, fat intake was 23%-28%, and protein intake was 17%-18% of total calories. In 2002, a

study by Moy and Suriah,<sup>18</sup> which was also conducted in the outpatient clinic of University of Malaya Medical Centre, found that patients with diabetes consumed a diet with 56.9% carbohydrate, 28.4% fat, and 14%-14.7% protein. In a recent study, patients with diabetes receiving treatment in tertiary care hospital reported the proportion of total calories from carbohydrate intake to be 60%, from fat intake 24%, and from protein intake 16%.<sup>19</sup> In aggregate, these findings suggest that Malaysians with diabetes tend to consume a diet high in carbohydrate and fat. Moreover, a recent study reported that a large proportion of Malaysian patients with diabetes are likely to consume 4 or more meals a day and more than 2 carbohydrate portions per snack.<sup>20</sup>

**Medical nutrition therapy.** Poor dietary adherence and physical inactivity among Malaysians with T2D complicates management strategies especially in patients with obesity. Excess adiposity increases insulin resistance and glucose intolerance, which increases the difficulty in treating patients with diabetes and overweight/obesity. Weight loss is, therefore, an important therapeutic objective for patients with diabetes to reduce insulin resistance. Moderate weight loss of just 5%-10% of body weight in patients with T2D has been found to decrease

insulin resistance and improve other metabolic risk factors.<sup>21,22</sup>

Medical nutrition therapy (MNT) that provides individualized nutrition recommendations, taking into account personal and culturally sensitive lifestyle preferences to achieve the target treatment goals, has been implemented for management of T2D in Malaysia. The first version of MNT was published in 2005 and updated in 2013.<sup>23,24</sup> In addition, Zanariah et al.<sup>25</sup> authored the Malaysian version of the transcultural Diabetes Nutrition Algorithm (tDNA) and outlined a suitable dietary prescription (Table 1) and physical activity (Table 2) prescription for Malaysians with diabetes. The effectiveness of MNT on glycemic control in people with diabetes has been well documented.<sup>27</sup> A dietitian-led MNT program for Malaysians with T2D showed a significant reduction of A1C (7.6 + 1.2 to 7.2 + 1.1%,  $P < .001$ ) and waist circumference (90.7 + 10.2 to 89.1 + 9.8 cm,  $P < .05$ ) over a 12-week period.<sup>27</sup> Dietary intake and nutrition knowledge scores (42 + 19 vs 75 + 17%;  $P < .001$ ) also improved significantly from baseline.<sup>27</sup>

Meal replacements are part of the Malaysian version of tDNA (Table 3).<sup>25</sup> Glycemia-targeted specialized nutrition meal replacement formulas contain certain nutrients and facilitate behaviors that can improve weight management and glycemic control. These formulas are available in Malaysia and may be used with nutritional counseling as meal or snack replacements for patients with overweight/obesity and diabetes for weight control, including those with high insulin requirements. These formulas are also indicated as a supplementary nutrition for patients with diabetes and normal weight with sub-optimal glycemic control, as well as those with diabetes and concurrent illness who are underweight or unable to maintain optimal nutrition because of reduced appetite and calorie intake. Recommendations for the use of meal replacements have been

incorporated in the revised MNT guidelines from the Malaysian Dietitians Association.<sup>24</sup>

**Physical activity.** There has been alarming evidence of increased sedentary lifestyle and physical inactivity among Malaysian adults. In a survey, 43.7% of adults did not adopt a physically active lifestyle, with 35.3% men and 50.5% women being classified as physically inactive.<sup>26</sup> In 2003, the Malaysian Adult Nutrition Survey studied the daily physical activity pattern from 24-hour physical activity recall and reported that Malaysian adults spent 89.3% of their day with light activities (1286 ± 1.3 minutes), 10.3% with moderate activities (148.68 ± 1.31 minutes), and only 0.4% with vigorous activities (5.12 ± 0.26 minutes).<sup>29</sup>

Studies assessing physical activity level and exercise among the general Malaysian population with diabetes are limited. However, several studies have been conducted in a subset of the Malaysian diabetes population. In a study conducted among people with T2D in the Cheras health clinic, 47% reported a moderate physical activity level, followed by 33.3% reporting a low physical activity level, and only 20% reporting a high physical activity level.<sup>30</sup> Moreover, it was also reported that 54% of Malaysian adults with diabetes were physically inactive.<sup>20</sup>

**Pharmacologic Management.** Currently there are 7 different classes of oral anti-hyperglycemic therapies available in Malaysia: biguanides, sulfonylureas, meglitinides, alpha-glucosidase inhibitors, thiazolidinediones, dipeptidyl peptidase IV (DPP-IV) inhibitors, and, recently, the sodium glucose transporter 2 (SGLT-2) inhibitors. Dopamine agonists and bile acid sequestrants are not registered for use as antihyperglycemic medications in Malaysia.

Metformin is the only biguanide available and represents the first-line treatment option in most newly diagnosed patients. The most common addition therapy to metformin currently is the sulfonylureas, followed by DPP-IV inhibitors. Newer

**Table 1. Nutrition Guidelines for the Management of Type 2 Diabetes\***

Calories	For overweight and obese individuals, a reduced-calorie diet of 20-25 kcal/kg body weight is recommended to achieve a weight loss of 5%-10% of initial body weight over a 6-mo period
Carbohydrate	45%-60% daily energy intake
Protein	15%-20% daily energy intake
Fat	25%-35% daily energy intake
Saturated fat	Less than 7% of total calories
Cholesterol	Less than 200 mg/d
Fiber*	20-30 g/d
Sodium	Less than 2400 mg/d

\* Should be derived predominantly from foods rich in complex carbohydrates, including grains (especially whole grains), fruits, and vegetables.<sup>26</sup>

**Table 2. Physical Activity Guidelines for the Management of Type 2 Diabetes\***

All patients	Frequency	Exercise 5 d/wk with no more than 2 consecutive d without physical exercise
	Intensity and type	Moderate-intensity activities include walking down stairs, cycling, fast walking, doing heavy laundry, ballroom dancing (slow), noncompetitive badminton, and low-impact aerobics
		Vigorous activities include jogging, climbing stairs, football, squash, tennis, swimming, jumping rope, and basketball
	Duration	150 min/wk of moderate-intensity aerobic physical activity and/or at least 90 min/wk of vigorous aerobic physical activity
Overweight or obese patients (BMI > 23 kg/m <sup>2</sup> )		Gradually increase physical activity to 60-90 min daily for long-term major weight loss

BMI, body mass index.

\* Patients should be assessed for complications that may preclude vigorous exercise. Age and previous physical activity level should be considered.<sup>26</sup>

generation sulfonylureas, in particular gliclazide, are currently favored over older generation sulfonylureas, such as glibenclamide, because of concerns of hypoglycemia, particularly in the elderly, those with polypharmacy, and those with significant coronary heart disease. The DPP-4 inhibitors were first introduced in 2005, and their use has continued to increase rapidly in the recent years, particularly in view of the concern for minimizing hypoglycemia and weight gain. There are currently 4 DPP-4 inhibitors available in Malaysia: sitagliptin, vildagliptin, saxagliptin, and linagliptin. Combination, fixed-dose formulations of metformin plus DPP-4 inhibitors are widely available in Malaysia, confer increased convenience and adherence, and are often prescribed. Thiazolidinedione prescriptions, both rosiglitazone and pioglitazone, are generally very

low in recent years in view of the concern for weight gain and fluid retention. Both meglitinides and acarbose, the only available alpha-glucosidase inhibitors, are infrequently prescribed because both require multiple divided doses, often resulting in reduced treatment adherence. A single SGLT-2 inhibitor, dapagliflozin, has been available since 2014, and its use is increasing gradually, in part because of an additional effect on weight loss.

Injectable medications to lower glucose include insulin and glucagon-like peptide-1 receptor analogues (GLP-1 RA). In public hospitals, insulin use has increased rapidly in the last decade as reported in the DiabCare Malaysia studies, from 28% in 2003, to 54% in 2008, and most recently to 65% in 2013.<sup>3,10,28</sup> In public hospitals, human insulin is prescribed in the majority of patients,

**Table 3. Glycemia-Targeted Specialized Nutrition (GTSN) for the Management of Prediabetes and Type 2 Diabetes\***

Overweight (BMI > 23 kg/m <sup>2</sup> ) or obese (BMI > 27.5 kg/m <sup>2</sup> )	Use meal and/or snack replacements <sup>†</sup> as part of a meal plan to reduce total calorie intake (i) Calorie reduction of 500-1000 calories/d (to lose 0.5-1.0 kg/wk), using 1-2 servings of a GTSN formula <sup>†</sup> to replace 250-500 calories from meals (ii) Reassess every 1-3 mo
Normal weight (BMI 18-23 kg/m <sup>2</sup> )	
Controlled diabetes (A1C ≤ 6.5% <sup>‡</sup> )	The use of meal replacements should be based on clinical judgment and individual assessment <sup>§</sup>
Uncontrolled diabetes (A1C > 6.5% <sup>‡</sup> )	Use 1-2 servings/d of a GTSN formula to be incorporated into a meal plan
Underweight (BMI < 18 kg/m <sup>2</sup> )	Use 1-3 servings/d of a GTSN formula as supplementation based on clinical judgment and individual assessment of desired rate of weight gain and clinical tolerance

A1C, hemoglobin A1c; BMI, body mass index; GTSN, glycemia-targeted specialized nutrition.

\* Recommendations were rated and assigned numerical and alphabetical descriptors according to levels of scientific substantiation provided by the 2010 American Association of Clinical Endocrinologists protocol for the development of Clinical Practice Guidelines.<sup>29</sup> Meal and snack replacements are nutritional products used as replacement for meals or snacks to replace calories in the diet. It is suggested that products used should meet the American Diabetes Association nutritional guidelines.

† Glycemia-targeted specialized nutrition formulas are complete and balanced products with at least 200 calories per serving, contains fiber and low glycemic index and used as part of a meal plan to help control calorie intake and achieve glycemic control.

‡ Glycemic (A1C) targets should be individualized for each patient based on local clinical practice guidelines.

§ To avoid hypoglycemia or postprandial hyperglycemia, individuals who may have muscle mass and/or function loss and/or micronutrient deficiency may benefit from a nutrition supplement. Individuals who need support with weight maintenance and/or a healthy meal plan could benefit from meal replacement.

with gradual increased use of insulin analogues in recent years, mainly in those at risk for hypoglycemia. The recent DiabCare 2013 study demonstrated increasing use of more intensive insulin regimens among patients attending hospital-based diabetes care with premixed insulin regimens prescribed most often, followed by the more intensive basal bolus insulin regimens, and least common is a basal insulin-only regimen.<sup>10</sup> Currently, there are 2 GLP-1 RA available in Malaysia: exenatide and liraglutide. Prescription of GLP-1RAs is generally low because of high cost and restricted use in public hospitals.

Current local clinical practice guidelines promote use of early combination therapy and the need to optimize medications without undue delay, toward achieving individualized glycemic targets, with a generally recommended A1C target of 6.5% or lower.<sup>14</sup> In the recent DiabCare 2013 study of patients attending public hospital outpatient diabetes clinics, only 13% achieved an A1C  $\leq$  6.5% and 24% recorded an A1C  $\leq$  7% at the time of the study.<sup>10</sup> Mean A1C values among patients in DiabCare study was 8.5% in 2013, compared with 8.7% in 2008.<sup>3,10</sup>

Cardiovascular risk reduction is an integral part of a comprehensive management plan for patients with diabetes. About 90% of patients attending hospital based diabetes clinics have hypertension, and the majority (73%) receive angiotensin-converting enzyme inhibitors or angiotensin receptor blockers for blood pressure control, followed by calcium channel blockers (48%), beta blockers (32%), and diuretics (26%).<sup>10</sup> Up to 90% of patients are treated for dyslipidemia, primarily with a statin, with up to 60% of patients achieving recommended low-density lipoprotein targets. Aspirin was used in 40% of patients for primary prevention.<sup>10</sup>

**Use of Technologies.** Insulin pump therapy was initiated in Malaysia in 2005, primarily among adolescent patients with T1D with poor control on multiple-dose insulin injections. The Medtronic brand of insulin pumps have been the only available choice, and currently there are approximately 170 local patients using insulin pump therapy, with an estimated 70% having T1D and the remaining having T2D. The majority of insulin pump therapy was initiated in adolescence, with an estimated 30% being started in adults with diabetes. Use of insulin pumps has been increasing in recent years, with up to 30–40 new patients initiated per year. There is a slow and gradual increase in insulin pump therapy among adult patients with T2D who remain poorly

controlled despite multiple insulin injections at high doses. Patients have improved glycemic control after initiation of pump therapy, not only because of the change in method of insulin delivery but also because of a better understanding of carbohydrate counting and the associated insulin requirement, along with more frequent blood glucose monitoring.

Continuous glucose monitoring (CGM) has also been available since 2005, exclusively with the Medtronic devices—initially with the CGMS Gold system and more recently with the i-Pro sensor device, which is more convenient and acceptable to patients, enabling glucose monitoring for either 3 or 6 days continuously. Recently, CGM has been incorporated in many local diabetes-related clinical research centers and its use in routine clinical practice has also increased in recent years. CGM represents an important educational tool to demonstrate to patients the relationship of blood glucose to daily activities and meals and to recognize patterns of dysglycemia that contribute to suboptimal glycemic control.

Some patients with diabetes are also using mobile technology, such as diabetes-specific mobile applications to aid their self-management. Health care providers are also providing treatment changes, such as insulin dose adjustments, via mobile technology.

## CHRONIC CARE MODEL

**General Remarks.** The development of a chronic care model (CCM) in the mid-1990s changed the perspective of Malaysian health care providers in managing noncommunicable chronic diseases.<sup>31,32</sup> Over the years, the model has been refined and expanded further to address multiple dimensions and specific issues in chronic disease management. This facilitates practical implementation, especially in middle and low income countries. The basic 6 components of a CCM are maintained for optimal interaction between the health system and the community:

- Organization of health care
- Delivery system design
- Decision support
- Clinical information systems,
- Self-management support
- Community resources and policies<sup>31,32</sup>

The prevalence rates of noncommunicable chronic diseases are growing, and associated mortalities, accounting for more than 60% of all deaths

around the world (35 million deaths each year, with 80% of these occurring in developing countries), are worrisome.<sup>33</sup> In fact, the World Health Organization (WHO) predicts that global mortality from chronic diseases will rise by 17.6% between 2006 and 2015.<sup>33</sup> Clearly, a change in approach to chronic disease is warranted. In response, WHO convened the representatives of low- and middle-income countries to expand the chronic care model into the Innovative Care for Chronic Conditions (ICCC) framework.<sup>34</sup> This initiative will help countries transform their health care system to create innovative strategies for chronic disease management, resulting in greater implementation and better outcomes.<sup>35–37</sup>

Translating a multifaceted diabetes care intervention in an underserved urban community using the CCM model resulted in a significant decrease in A1C (−0.6%) and non-high-density lipoprotein cholesterol (−10.4 mg/dL), improvement in high-density lipoprotein cholesterol (+5.5 mg/dL), and increase in self-monitoring blood glucose (+22.2%) compared with the usual care group.<sup>38</sup> In addition, a relatively modest clinician-level effort to incorporate elements of the CCM into their daily practices was associated with significantly improved processes and outcomes of diabetes care.<sup>39</sup> In a rural South African setting, a nurse-led chronic disease management program for high blood pressure, diabetes, asthma, and epilepsy improved disease control in 68% patients with hypertension, 82% of patients with diabetes, and 84% of patients with asthma.<sup>40</sup> The CCM and ICCC framework also teaches physicians new communication skills.<sup>41</sup>

**Applying the CCM to the Malaysian Primary Care Clinic Setting.** In Malaysia, the burden of managing diabetes falls squarely on primary health care providers operating in various settings. There are about 1037 governmental health clinics around Malaysia operating under the Ministry of Health Malaysia policy. To date, there is no official integration among these health clinics and the private health clinics managed by private medical practitioners. However, there are initiatives in the pipeline to integrate these 2 systems.

Currently, the Malaysian health system governing health clinics is oriented toward the care of acute, episodic illnesses, as well as maternal and child health. Examples include dengue fever, tuberculosis, and acute emergencies. Adaptation of the delivery system and decision support for these acute illnesses are relatively nimble in primary care settings despite pressures on human resources. In

contrast, management of chronic diseases in Malaysia, especially diabetes, has not enjoyed the same progress and agility, particularly in the context of CCM and ICCC framework components. More specifically, the defining features of primary care management of chronic disease in Malaysia—continuity, comprehensiveness, and coordination—are sporadic and fragmented. In order to address this shortcoming, the 6 key CCM components of Malaysian primary care, provided by the Ministry of Health, will need to be optimized. Descriptions of the specified problems for each component are given next.

**Component 1: Organization of health care.** Even though Malaysian health care clinics operate within the jurisdiction and aspiration of the Ministry of Health, each clinic has its own delivery system design based on individual strengths and weaknesses in a nonstandardized manner. One clinic may have a specific diabetes team led by trained medical personnel, and others may not have a team at all. A clinic may have a specialist to steward focused diabetes care, and another clinic may not even have a resident medical officer to lead the service. This may be explained by the diversity of the community and logistic variations of the clinic location. Generally, a clinic in an urban area is better equipped than a clinic in a rural area. As a whole, human resources and technical input are deficient with variations depending on funding, available information technology, and specialist support.

**Component 2: Delivery system support.** The elements of delivery system support are defining specific roles and distributing work appropriately, implementing evidence-based care, incorporating planned interactions and regular follow-up, and ensuring a culturally sensitive strategy. Unfortunately, within Malaysian primary health care settings, dedicated diabetes teams led by trained personnel are generally lacking. As a result, there are multiple programs in the clinic setting, leading to multitasking, inefficiency, and suboptimal care.

**Component 3: Decision support.** Clinical practice guidelines for the management of diabetes are available in almost all health clinics and are widely used by all levels of health care professionals in Malaysia. Domestic and international clinical practice guidelines CPG are also used to train medical personnel to ensure empowerment, standardization, and effective dissemination of knowledge. However, a general lack of family medicine specialists, diabetologists, and endocrinologists to conduct hands-on workshops, practice-based

learning, and other structured training formats in a consistent manner still leads to inadequate decision support. This is further complicated by medical inertia that is discerned in chart audits. Moreover, fast turnover of medical personnel creates inconsistency and disrupts standardization in diabetes care even though a decision support component is in place.

**Component 4: Clinical information system.** There are only a handful of health clinics in Malaysia with Electronic health records or primary telecare. The majority of clinics have manual documentation, including investigational results tracings. Thus it is very difficult to compare the efficiency in the clinical information system throughout the country. The National Diabetes Registry (NDR) of the Ministry of Health in Malaysia helps to accumulate data and generate data analyses, but it is very dependent on humans to input information. Therefore, the NDR needs laborious and tedious updating and data mining to accurately reflect the true burden and performance of a clinic. Despite these shortfalls, the NDR has helped clinics optimize their organization and improve their performance. However, many more initiatives need to be in place if defaulter tracings,<sup>1</sup> patient's tracings, and clinical audits are to significantly improve the efficiency of diabetes care.

**Component 5: Self-management support.** In order to support decision making in Malaysian communities, diabetes self-management training and support by certified/noncertified diabetes educators is essential. Diabetes educators play an integral role in comprehensive diabetes care, but there is a significant shortfall of these specialists. Currently there are not enough paramedics trained in diabetes education, so the lack of supervision, guidance, and support for diabetes self-management is very obvious and ultimately detrimental to patients and the community. The lack of diabetes self-management leads to complications and co-morbidities that increase mortality and overall health care costs.

**Component 6: Community resources and policies.** There is an obvious inadequacy of resources and policies in clinic and community settings in Malaysia. Even though there are initiatives rolled out by the Malaysian Ministry of Health that integrate prevention and screening activities in both communities and clinics,

the overall continuity and impact is minimal. Health camps run by the clinics for the vicinity yield poor follow-ups and continuity of care. Community resources organized and implemented by non-governmental organizations are poorly utilized by patients with diabetes. Policies governing the promotion of a healthy lifestyle for patients with diabetes are yet to be implemented.

The lack of CCM component implementation, let alone the ICCC framework in the primary care clinics in Malaysia, poses a challenge to medical practitioners, key opinion leaders, and specialists in improving the management of diabetes and other chronic illnesses. This uphill battle requires deliberate coordination from various agencies to improve diabetes care in Malaysia.

**Solutions: Model Expansion for Malaysia.** The application of innovative components of the ICCC framework advocated by WHO into the primary health care setting in Malaysia can potentially maximize returns from limited resources by shifting from an acute to chronic care model.<sup>42,43</sup> Change needs to occur through successful re-engineering of the primary care health care system in Malaysia. This will lead to better health for future generations and meet the needs of a growing population of patients with chronic conditions.

Transforming the health care system by integrating the CCM ICCC framework components appears onerous because of the presumed increased resources and funding believed to be necessary. Perhaps more influential is the further presumption that concurrent integration of these innovative components is necessary. Yet, despite the apparent heavy lifting needed, a stepwise approach may be the real answer. The first step would be to parse out the components and then prioritize based on realistic goals, followed by optimization of each step in succession.

**Organization of health care.** Clinics provide important advocacy to various authoritative agencies in the community. As a result, diabetes clinic teams can collaborate with government agencies and individual leaders at the community level, as well as the social welfare department, family, and health ministry levels. This interaction can build programs that promote healthy lifestyles, personal empowerment, and physical activity programs. For example, a simple program on how to cook healthy meals would have a pragmatic and positive impact in the community.

**Delivery system design.** Redesigning the delivery system by focusing on outcomes and biomarkers

<sup>1</sup>Defaulter tracing is an activity to identify patients who failed to attend their clinic appointments after 2 weeks passed, and making contacts with the patients to inform them of their new appointment dates.

(eg, A1C, BMI, or low-density lipoprotein cholesterol) rather than care processes (eg, rates of laboratory testing or use of medical therapies) has resulted in significant improvement in diabetes care.<sup>44</sup> Quality measure improvements can be interpreted as a hopeful sign that better outcomes will result with integration of the CCM components.<sup>44</sup> Thus, this process could start by developing a primary care team in a primary care clinic setting, instead of an overly ambitious system change.<sup>45,46</sup>

In a subsequent step, a multidisciplinary diabetes team could be formed, led by a family medicine specialist, and consist of a medical officer, pharmacist (trained in diabetes medical therapy adherence), certified or trained diabetes educators, case manager (paramedic), dietitian/nutritionist, physical therapist, occupational therapist, and counselor. This staffing list can expand depending on the resources available. Team members can be individuals working in the specific clinic or from outsourcing. Some clinics in Malaysia have medical social workers as part of the diabetes team enabling continuity of care for this chronic disease. The further design and optimization of the diabetes team is a creative process that needs a nurturing environment sanctioned by the government or other oversight agents.

Diabetes care outcomes can be improved by regular and sustained follow-up, personalized care through scheduled and unscheduled visits by specified team members, regular individual and group diabetes education, scheduled fundus and foot examinations, regular screening of comorbid conditions, and regular sessions with pharmacists and dietitians.<sup>47,48</sup> Even regular visits to the physical therapist improves conditioning and glucose tolerance.<sup>49</sup> Activities need to be well coordinated, documented, and followed up for accurate assessment of outcomes. Team members need to be dedicated and able to concentrate on therapeutic activities. Regular meetings with team members on progress, analysis of shortfalls, and enhancing positive initiatives will advance the objectives of chronic disease management. The diabetes team can also improve community engagement by making contacts with family members, friends, colleagues, and other entities in the vicinity.

**Decision support.** The success of the diabetes team in terms of disease management is facilitated by clinical practice guidelines, particularly the local Malaysian version, as well as international documents published by the American Diabetes Association, International Diabetes Federation, American

Association of Clinical Endocrinologists, and others. Regular graded trainings of health care professionals on these and other white papers, patient-based learning with specialists, hands-on workshops, and case discussions with team members assist decision-making performance regarding the best individualized option for the patient. A wide distribution of these and other educational materials from specialists further informs the decision-making process.<sup>50</sup>

**Clinical information system.** The clinical information system can be expanded beyond the usual application of registries, audits, and tracking systems by linking various products to one another. This can then be leveraged to educate the public and community on disease prevalence, risk factors, and societal impact. The information can also be made accessible in the waiting area of the clinic for patient education. Additionally, the information can also be used by local advocacy groups, recreation centers, and service clubs. Data can be updated and refreshed regularly, portraying up-to-date health risks, specific at-risk groups, disease characteristics, and ways to mitigate adverse health conditions.

**Self-management support.** Diabetes self-management education develops personal health, wellness, and skills in managing diabetes. The self-management paradigm empowers diabetes patients and can be extrapolated to smoking cessation and other beneficial lifestyle changes. Through this approach, patients who want to quit smoking but are unable can be referred to various structured tobacco cessation programs; patients who want to lose weight but are unable can be referred to various structured weight loss programs provided by various private and government agencies; and as for the smoking cessation programs, health clinics do provide in-house smoking cessation services that include counseling, pharmaceutical therapies, and so forth.

**Community resources and policies.** Creating a healthy environment has a significant impact on social support of overall health and quality of life. The Healthy Communities initiative in Canada demonstrates value in the ability to involve multiple partners at the community level to build a shared vision, seek consensus, and take action on local concerns.<sup>50</sup> The presence of multiple CCM components allows for significant interactions among prepared, proactive diabetes practice teams and informed, activate patients.<sup>42,51</sup> These interactions are enhanced in the expanded CCM scope

**Table 4. Key points about diabetes management in Malaysia**

Factors	Findings
Epidemiology	Over the past decade, prevalence of T2D increased from 14.9% in 2006 to 20.8%, affecting 2.8 million individuals in 2011 with highest prevalence in Indian ethnicity, followed by Malays and Chinese. Glycemic control is poor, with mean A1C levels rising from 8.66% in 2008 compared with 8.0% in 2003, and only 22% of T2D individuals achieved the glycemic target of A1C < 7%
Disease complications	High microvascular complication rate possibly as a result of improved rates of complication screening with foot examination, urinalysis, and retinal assessment performed in more than 90% of patients; cardiovascular complications were lower, with the exception of cerebrovascular events
Follow-up care settings	An estimated 1.1 million received treatment at public health care facilities. <sup>11</sup> Of those receiving public-based health care, an estimated 70% attended primary care clinics, whereas the remaining received treatment and follow-up at public hospitals <sup>1</sup>
Diabetes education support	There are established diabetes resource centers in most hospitals where trained diabetes nurse educators deliver patient-centered diabetes education both to inpatients and outpatients. Multidisciplinary care from doctors, diabetes educators, dietitians, and pharmacists
Diet, lifestyle, and physical activity	Poor physical activity and dietary adherence with high consumption of carbohydrates among patients are common
Pharmacologic treatment	Seven different classes of oral antihyperglycemic therapies are available—biguanides, sulfonylureas, meglitinides, alpha glucosidase inhibitors, thiazolidinediones, dipeptidyl peptidase IV inhibitors, and sodium glucose transporter 2 inhibitors. Metformin is the first-line treatment option. Injectable medications include insulin and glucagon-like peptide-1 receptor analogues. In public hospitals, insulin use has increased rapidly in the last decade. Use of insulin pumps and CGM available
Expanding the chronic care model into the WHO Innovative Care for Chronic Conditions framework in primary care	Stepwise approach to implement each of the 6 components of the chronic care model: prioritize based on realistic goals, then optimize in succession

A1C, hemoglobin A1c; CGM, continuous glucose monitoring; T2D, type 2 diabetes; WHO, World Health Organization.

proposed for the Malaysian setting to improve diabetes care.

A comprehensive strategy is provided in [Table 4](#). This approach has been put into place by the

Malaysian government to improve prevention, treatment, and control of diabetes in order to urgently address the growing burden associated with this chronic disease.

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